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Catalogue of UNITED STATES NAVAL POSTGRADUATE SCHOOL

ACADEMIC YEAR

1950 • 1951

POSTGRADUATE SCHOOL ANNAPOLIS, MARYLAND

NAV PERS 15779

CATALOGUE OF

U. S NAVAL POSTGRADUATE SCHOOL

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PART I

GENERAL

STAFF OF THE NAVAL POSTGRADUATE SCHOOL

Officers

E. E. Herrmann	R. Adm., USN	Superintendent
H. T. Walsh	Capt. USN	Assistant Superintendent

Aerological Engineering

W. Loveland	Capt. USN	Officer in Charge
W. J. Francis, Jr.	Cdr. USN	
P. T. Jorgensen	Lcdr. USN	
M. C. Jack	Lcdr. USN	
W. R. Green	C. H. Aero. USN	

Aeronautical Engineering

E. S. Lee, Jr.	Cdr. USN	Officer in Charge
V. C. Tompkins	Cdr. USNR	

Communications

J. S. Dorsey	Capt. USN	Officer in Charge
M. J. Smith	Cdr. USN	
J. L. May	Cdr. USN	
R. S. Rankin	Lcdr. USN	

Electronics Engineering

W. C. Schultz	Capt. USN	Officer in Charge
S. H. Walsh	Lcdr. USN	
G. J. Stetka	Lt. j.g. USN	

Naval Engineering

R. W. Cavenagh	Capt. USN	Officer in Charge
T. H. Brittan	Cdr. USN	
J. P. Craft	Cdr. USN	

Ordnance Engineering

E. K. Walker	Capt. USN	Officer in Charge
C. W. Travis	Cdr. USN	
R. A. Thacher	Cdr. USN	

R. C. Harwood	Cdr. USN	Administrative Officer
G. C. Foltz	Lcdr. USN	Asst. Administrative Officer
L. S. Helmeci	Lt. USN	Comm. Officer

CIVILIAN FACULTY

Glasgow, Roy S., B.S. in E.E., M.S., E.E.	Academic Dean
Root, Ralph E., B.S., M.S., Ph.D.	Senior Prof. of Mathematics (Emeritus)
Fowler, Harold E., A.B; B.L.S.	Librarian

Aerology

Duthie, William D., A.B., M.S., Ph.D.	Chairman; Prof. of Aerology
Haltiner, George J., B.S., Ph.M., Ph.D.	Assoc. Prof. of Aerology
Martin, Frank L., A.B., M.A., Ph.D.	Assoc. Prof. of Aerology

Aeronautics

Coates, Wendell M., A.B., M.S., D.Sc.	Chairman; Prof. of Aeronautics
Borg, Sidney F., B.S. in C.E., M.C.E.	Asst. Prof. of Aeronautics
Dennis, Ward B., B.Ac.E., M.S.E. (Ae)	Asst. Prof. of Aeronautics
Head, Richard M., B.S., M.S., My., M.S., Ae.E., Ph.D.	Assoc. Prof. of Aeronautics
Higgins, George J., B.S. in Eng. (Ae.E.), Ae.E.	Prof. of Aeronautics
Kahr, Charles H., B.S. (Ae.E.), M.S.E. (Ae).	Asst. Prof. of Aeronautics
Kohler, Henry L., B.S., M.S. M.E.	Prof. of Aeronautics
Meyer, Rudolph X., Dipl. Ing.	Asst. Prof. of Aeronautics
Rottmeyer, Earl, B.S. in M.E., M.S.E. (Ae).	Asst. Prof. of Aeronautics
Vavra, Michael H., Dipl. Eng.	Prof. of Aeronautics

Electrical Engineering

Terwilliger, Charles V.O., B.E., M.S.in E.E., Dr. Eng.	Chairman; Prof. of Electrical Engineering
Oler, Charles B., B.S., M.S.	Asst. Prof. of Electrical Engineering
Polk, Orval H., B.S. in E.E., E.E., M.S.	Assoc. Prof. of Electrical Engineering
Pula, Thaddens J., B.E.	Inst. of Electrical Engineering

Electrical Engineering (Con't)

Rothauge, Charles H., B.E.; Dr. Eng	Asst. Prof. of Electrical Engineering
Smith, W. Conley, B.S. in E.E.; M.S.	Asst. Prof. of Electrical Engineering
Vivell, Allen, E.; B.E.; Dr. Eng.	Prof. of Electrical Engineering
Wheeler, Richard C.H.; B.E.; D. Eng.	Prof. of Electrical Engineering

Electronics and Physics

Frey, Austin R.; B.S.; M.S.; Ph.D.	Chairman; Prof. of Physics
Bauer, Robert E.; B.S.	Instr. of Electronics
Bauer, Wm. Malcolm, B.S.; E.E.; M.S., D.Sc	Assoc. Prof. of Electronics
Chaney, Jessee G., A.B., M.A.	Prof. of Electronics
Cunningham, William P., B.S., Ph.D	Prof. of Physics
Cooper, Paul E.; B.S.; M.S.	Assoc. Prof. of Electronics
Giet, G. Robert, A.B., E.E.	Prof. of Electronics
Goddard, Earl G.; B.S. in E.E.; M.A.; E.E.	Asst. Prof. of Electronics
Healy, Daniel W.; B.S., M.A. (on leave)	Asst. Prof. of Electronics
Kalmbach, Sydney H.; B.S.; M.S.	Asst. Prof. of Physics
Kinsler, Lawrence E., B.S., Ph.D.	Prof. of Physics
Koehler, Wilfred F., B.S., M.A., Ph.D.	Assoc. Prof. of Physics
Menneken, Carl E., B.S., M.S.	Prof. of Electronics
Miller, Robert L.; B.Ed., M.S.	Asst. Prof. of Electronics
Oleson, N.S., B.S., M.S., Ph.D.	Asst. Prof. of Physics

Electronics and Physics (Con't.)

Roadstrum, William H., B.S. in E.E., M.S. in E.E.	Asst. Prof. of Electronics
Sheingold, Abraham, B.S., M.S.	Asst. Prof. of Electronics
Wilson, Robert D., B.S.	Asst. Prof. of Electronics

Mathematics and Mechanics

Church, W. Randolph, A.B., M.A., Ph.D.	Chairman; Prof. of Math. & Mech.
Bleick, Willard E., M.E., Ph.D.	Assoc. Prof. of Math. & Mech.
Campbell, Richard C., B.S., M.A.	Asst. Prof. of Math & Mech.
Faulkner, Frank D., B.S., M.S.	Asst. Prof. of Math & Mech.
Giarratana, Joseph, B.S., Ph.D.	Assoc. Prof. of Math. & Mech.
Jennings, Walter, A.B., B.S., M.A.	Asst. Prof. of Math. & Mech.
Lockhart, Brooks J., A.B., M.S., Ph.D.	Asst. Prof. of Math. & Mech.
Mewborn, A. Boyd, B.S, M.S., Ph.D.	Assoc. Prof. of Math. & Mech.
Pulliam, Francis M., A B., M.A., Ph.D.	Asst. Prof. of Math. & Mech.
Rawlins, Charles H., Ph.B., M.A., Ph.D.	Prof. of Math. & Mech.
Torrance, Charles C., M.E., M.A., Ph.D.	Assoc. Prof. of Math. & Mech.

Mechanical Engineering

Kiefer, Paul J., A.B., B.S. in M.E., M.E.	Chairman; Senior Prof. of Mech. Eng.
Gatcombe, Ernest K., B S. in M.E., M.S. in M.E. Ph.D.	Assoc. Prof. of Mech. Eng.
Kavanaugh, Dennis, B.S. in M.E.	Prof. of Mech. Eng.
Lee, George H., B.S., M.S. in Eng., Ph.D.	Assoc. Prof. of Mech. Eng.
Prowell, Roy W., B.S. in Indus. Eng'g., M.S.in M.E.	Asst. Prof. Mech. Eng.
Wright, Harold M., B.S. in M.E., M.M.E.	Assoc. Prof. of Mech. Eng.

Metallurgy and Chemistry

Coonan, Frederick L., A.B., M.S., D.Sc.	Chairman; Prof. of Metal. & Chem.
Buerger, Newton W., B.S., M.S., Ph.D.	Prof. of Metal.
Clark, John R., B.S., Sc.D.	Assoc. Prof. of Metal.
Hering, Carl A., B.S. in Ch.E., M.S.	Asst. Prof. of Chem. Eng.
Kinney, Gilbert F., A.B., M.S., Ph.D.	Prof. of Chem. Eng.
Marshall, George D. Jr., B.S., M.S.	Assoc. Prof. of Metal.
McFarlin, George H., A.B., M.A.	Assoc. Prof. of Chemistry
Reynolds, Melvin F., B.S., M.S., Ph.D.	Assoc. Prof. of Chemistry
Sinclair, James E., B.S.	Asst. Prof. of Chemistry
Wilson, James W., A.B., B.S., M.S.	Asst. Prof. of Chem. Eng.

Research Personnel

Smith, Lois R., A.B.	Dept. of Metal. & Chem.

ACADEMIC ASSOCIATES

Aerological Engineering

William D. Duthie, A.B., M.S., Ph.D.	Prof. of Aerology

Aeronautical Engineering

Wendell M. Coates, A.B., M.Sc., D.Sc.	Prof. of Aeronautics

Communications

G. Robert Giet, A.B., E.E.	Prof. of Electronics

Electronics Engineering

G. Robert Giet, A.B., E.E.	Prof. of Electronics

General Line School

Frank E. La Cauza, B.S. in E E., M.S in E.E., M.A.	Prof. of Electrical Eng.

Naval Engineering

Orval H. Polk, B.S in E.E., E.C., M.S.	Assoc. Prof of Electrical Eng.

Ordnance Engineering

Richard C. H. Wheeler, B.S., D Eng.	Prof of Electrical Eng.

TERM CALENDAR 1950 - 1951

Summer Term	Monday 14 August	-	Friday 20 October
Seminar Week	Monday 23 October	-	Friday 27 October
Fall Term	Monday 30 October	-	Friday 19 January
Seminar	Monday 22 January		
Winter Term	Tuesday 23 January	-	Monday 2 April
Seminar Week	Tuesday 3 April	-	Friday 6 April
Spring Term	Monday 9 April	-	Friday 15 June

Christmas Leave Period:	December 20, 1950	-	January 2, 1951
Field Trips:	June 18	-	July 27, 1951
Intersessional Leave Period:	July 29	-	August 12, 1951

The following days have been designated holidays and no classes will be held:

4 September 1950 Monday

11 November 1950 Saturday

23 November 1950 Thursday

25 December 1950 Monday

1 January 1951 Monday

22 February 1951 Thursday

30 May 1951 Wednesday

4 July 1951 Wednesday

POSTGRADUATE SCHOOL TRAINING PROGRAM

The general plan for officer education is set forth in the Bureau of Naval Personnel Manual: Chapter D Section 3.

D-1301

(1) FUNCTIONS.--The pos graduate School, with headquarters at the Naval Academy, Annapolis, is established for maintaining courses of instruction for the advanced education and training of commissioned officers in such general or technical subjects as the Secretary of the Navy may prescribe. Postgraduate courses are conducted both at the Postgraduate School and at private institutions. Whether conducted at the Postgraduate School or elsewhere, all postgraduate courses are under the cognizance of and directed by the superintendent of the Postgraduate School.

(3) SELECTION OF OFFICERS.--Selection of officers applying for postgraduate instruction is made by boards appointed by the Chief of Naval Personnel. The courses available, the conditions of eligibility, and other pertinent data are published annually in Bureau of Naval Personnel circular letters.

(6) POSTGRADUATE SCHOOL CATALOGS.--Detailed information relative to the curriculum for each postgraduate course is given in the annual postgraduate school catalog. This catalog is given wide distribution and should be studied by officers interested in postgraduate training.

THE REGULATIONS GOVERNING THE POSTGRADUATE SCHOOL

The Naval Postgraduate School was established in 1909 as an activity of the U. S. Naval Academy by direction of the Navy Department. The increasing emphasis placed on the advanced technical training of Naval Officer Personnel by the Navy Department, during the past several years, is reflected by the passage of three acts by congress affecting the academic and physical stature of the Postgraduate School. These three acts authorized the School to grant advanced degrees in engineering and related fields, created the civilian position of academic dean and established the U. S. Naval Postgraduate School as a separate naval activity.

The first act passed by congress, designed to emphasize the academic level of the School, was Public Law 250, 79th Congress, 1st Session. This act authorized the School to grant Bachelor's, Master's and Doctor's degrees in engineering and related subjects. Although this authority was not exercised for two years after passage of the act, suitable courses of study were instituted as rapidly as possible. Public Law 402, 79th Congress, 2nd Session, created the civilian position of Academic Dean. This position was established to insure continuity of academic policy.

The United States Naval Postgraduate school was established as a separate naval activity by Public Law 303, 80th Congress, 1st Session. This act authorized the Secretary of the Navy to establish the School for the advanced training of commissioned officers of the Navy and Marine Corps. The military command of the School was vested in an officer of the Regular Navy, not below the rank of captain, to be appointed by the Secretary of the Navy, to serve as Superintendent. The Secretary of the Navy was also authorized to employ at the School, under the direction of the Superintendent, a civilian faculty of adequate size to meet the objective of the School. The two previous acts were amended to apply to the newly formed U. S. Naval Postgraduate School.

In addition to the School at Annapolis, which is primarily for engineering student officers, the Superintendent is responsible for an Intelligence School in Washington, D.C. and General Line Schools at Newport, R.I. and Monterey, Calif.

MISSION

From the above regulations, the mission of the Postgraduate School is taken to be:

TO CONDUCT AND DIRECT THE ADVANCED INSTRUCTION AND TRAINING OF COMMISSIONED OFFICERS IN THE PRACTICAL AND THEORICAL DUTIES IN ORDER TO MEET THE REQUIREMENTS OF THE NAVY

T A S K

TASK: 1. To provide the advanced education necessary for selected groups of officers to develope profieciency in design, inspection and installation of material, with attendant research problems, and to provide practical and theoretical training necessary for officers to serve in special branches of the Naval services by:

(a) Planning, conducting and maintaining suitable postgraduate courses at the U. S. Naval Postgraduate School, Annapolis, Maryland, and at selected civilian institutions.

(b) Organizing, planning and directing General line Curricula at Newport, Rhode Island, and Monterey, California.

(c) Organizing, planning and directing the conduct of a Naval Intelligence course at Naval School (Naval Intelligence), Receiving Station, Washington, D C.

REGULATIONS GOVERNING THE AWARD OF ADVANCED DEGREES

1. Master's or Doctor's degrees in engineering or related fields may be awarded by the Superintendant of the United States Naval Postgraduate School upon recommendation of the Faculty based upon satisfoctory completion of a course of advanced study arranged by a Curriculum Committee, approved by the Academic Council (consisting of the Academic Dean, the Director of the School of Engineering and the civilian chairman of the Academic Departments) and complying with the regulations set forth hereunder.

REQUIREMENTS FOR THE MASTER'S DEGREE

(a) The Master's degree in engineering and related fields is awarded for the successful completion of a curriculum which complements the basic scientific education of a student and which has been approved by the Academic Council as meriting a degree, provided the student exhibits superior scholorship, attains scientific proficiency, and meets additional requirements as stated in the following paragraphs.

(b) Since curricula serving the needs of the Navy ordinarily contain undergraduate as well as graduate courses a minimum of two academic years of residence at the U. S. Naval Postgraduate School is normally required. With the approval of the Academic Council, the time of residence may be reduced in the case of particular students who have successfully pursued graduate study at other education institutions. In no case will the degree be granted for less than one academic year of residence at the U. S. Naval Postgraduate School.

(c) A curriculum leading to a Master's degree shall comprise not less forty-eight term hours (32 semester hours) of work that is clearly of graduate level, and shall contain a well-supported major together with cognate minors. At least six of the term hours shall be in advanced mathematics-Proposed program shall be submitted to the cognizant Department Chairman for review and approval. If the program is satisfactory to the Department Chairman it shall be forwarded by him to the Academic Council for final action.

(d) To become a candidate for the Master's degree, the student shall have completed at least three quarters of the graduate credit courses of his curriculum with a quality point rating in them of not less than 1.75 as defined in the section on scholarship.

(e) To be eligible for the Master's degree, the student must attain a minimum average quality point rating of 2.0 in all graduate credit courses; 1.5 in all of his other courses. In special cases, under very extenuating circumstances, small deficiencies from the figures noted in paragraphs (d) and (e) may be waived at the discretion of the Academic Council.

(f) A resonable proportion of the graduate work leading to the Master's degree shall comprise research and a thesis reporting the results obtained. The thesis topic may be selected by the student, subject to the approval of the cognizant Department Chairman. The completed thesis must indicate ability to perform independant work and to report on it in a scholarly fashion. The thesis, in final form, will be submitted to the cognizsnt Department Chairman for review and evaluation. Upon final approval of the thesis by the Department Chairman, the student shall be certified as eligible for final examination.

(g) If the thesis is accepted the candidate for the degree shall take a final oral examination the duration of which will be approximately one hour. An additional comprehensive written examination may be required at the discretion of the cognizant Department Chairman. Not more than one-half of the oral examination shall be devoted to questions directly related to the candidate's thesis topic; the remainder to the candidate's major and related areas of study.

(h) With due regard for the above requirements, the Academic Council will decide whether to recommend the candidate to the Superintendant of the U. S. Naval Postgraduate School for the award of the Master's Degree.

REQUIREMENTS FOR THE DOCTOR'S DEGREE

(a) The Doctor's degree in engineering and related fields is awarded as a result of very meritorious and scholarly achievement in a particular field of study which has been approved by the Academic Council as within the purview of the U.S. Naval Postgraduate School. A candidate must exhibit faithful and scholarly application to all prescribed courses of study, achieve a high level of scientific advancement and establish his ability for independent investigation, research and analysis. He shall further meet the requirements described in the following paragraphs.

(b) Any program approved as leading to the Doctor's degree shall require the equivalent of at least three academic years of study beyond the undergraduate level, and shall meet the needs of the Navy for advanced study in the particular area of investigation. At least one academic year of the doctorate work shall be spent at the U. S. Naval Postgraduate School.

(c) A student seeking to become a candidate for the Doctorate shall hold a Bachelor's degree from a college or university, based on a curriculum that included the prerequisites for full graduate status in the department of his major study, or he shall have pursued successfully an equivalent course of study. The student shall submit his previous record to the Academic Council, via the Academic Dean, for final determination of the adequacy of his preparation.

(d) Upon favorable action by the Academic Council the student will be notified that he may request the Chairman of the Department of his major subject to form a doctorate committee. This chairman will specify one or more minor subjects and, with the chairman of the corresponding departments, will nominate a doctorate committee consisting of five or more members, at least three of whom are under different departments. The chairman of the department of the major subject will submit to the Academic Council for its approval the choice of minor fields and the names of the faculty members nominated for the doctorate committee

(e) After a sufficient period of study in his major and minor fields the student shall submit to qualifying examinations, including tests of his reading knowledge of foreign languages. The selection of these languages depends on the field of study. The minimum is a reading knowledge of German and a second language to be suggested by his doctorate committee and approved by the Academic Council. The language examinations will be conducted by a committee especially appointed by the Academic Council. The other qualifying examinations will cover material previously studied in his major and minor fields; they will be written and oral and will be conducted by the doctorate

committee. The members of the Academic Council or their delegates may be present at the oral examinations. The doctorate committee will report the results of the qualifying examinations to the Academic Council for consideration and upon approval the student becomes a candidate for the doctorate. The qualifying examinations are ordinarily not given before the completion of the first year of residence at the U. S Naval Postgraduate School; they must be passed successfully at least two years before the degree is granted.

(f) Upon successful qualification as a candidate the doctorate committee will propose a further program of study. This program must be approved by the Academic Council.

(g) The distinct requirements of the doctorate is the successful completion of an original, significant and scholarly investigation in the candidate's major area of study. The results of the investigation, in the form of a publishable dissertation, must be submitted to the Academic Council at least two months before the time at which it is hoped the degree will be granted. The Academic Council will select two or more referees who will make individual written reports on the dissertations Lastly, the Academic Council will vote upon the acceptance of the dissertation.

(h) After the approval of the dissertation and not later than two weeks prior to the award of the degree the candidate will be subject to written and oral examinations in his major and minor subjects Written examinations will be conducted by the department having cognizance of the particular subjects. The occasions and scope of all examinations will be arranged by the doctorate committee after consultation with the departments concerned and the members of the Academic Council The doctorate committee will notify the Academic Council of the time of the oral examination and will invite their attendance or that of their delegates. The committee will also invite the attendance of such other interested persons as it may deem desirable In this oral examination approximately one half of the allotted time will be devoted to the major subject and one half to the minor subjects. The doctorate committee will submit the results of all examinations to the Academic Council for their approval.

(i) With due regard for all of the above requirements the Academic Council will decide whether to recommend the candidate to the Superintendent of the U. S. Naval Postgraduate School for the award of the doctorate.

REQUIREMENTS FOR THE BACHELOR'S DEGREE

Public Law 303, 80th Congress, Second Session, authorizes the Superintendent of the U. S. Naval Postgraduate School to confer the Bachelor of Science degrees in Engineering and related fields, 'Pursuant to such regulations as the Secretary of the Navy may prescribe.....upon due accreditation.....by the appropriate professional authority'.

The Naval Postgraduate School has been accredited by the Engineers Council for Professional Development. The award of these degrees will be limited to those student officers enrolled on or subsequent to 31 July 1947. Pursuant to the Provisions of Public Law 303, the following regulations governing the award of Bachelor of Science degrees are outlined.

(a) The BACHELOR'S degree in engineering or other scientific fields may be awarded for the successful completion of a curriculum which serves the needs of the Navy and has the approval of the Academic Council as meriting a degree. Such a curriculum shall conform to current practice in accredited engineering institutions and shall contain a well defined major with appropriate cognato minors.

(b) Admission with suitable advanced standing and a minimum of two academic years of residence at the U. S. Naval Postgraduate School are normally required. With the approval of the Academic Council, this residence requirement may be reduced to not less than one academic year in the case of particular students who have had sufficient prior preparation at other institutions.

(c) To be eligible for the degree, the student must attain a minimum average quality point rating of 1.0 in all the courses of his curriculum. In very exceptional cases, small deficiencies from this figure may be waived at the discretion of the Academic Council.

(d) With due regard for the above requirements the Academic Council will decide whether to recommend the candidate to the Superintendent of the U. S. Naval Postgraduate School for the award of the Bachelor's Degree.

SCHOLARSHIP STANDARDS

(1) Student officers enrolled in the U. S. Naval Postgraduate School will be rated academically by Quality Points attained, and this rating will be determined in the following manner:

Grade	Quality Points
A	3.0
B	2.0
C	1.0
D	0
X	-1.0

Quality Point Rating shall be calculated by dividing the sum of the products of assigned quality points and credit hours in each course by the total number of credit hours obtained. Each one hour lecture or recitation period per week or each two hour laboratory or P. W. period will count as one credit hour.

(2) Following the number of the course the status is indicated by the following letters following the course:

(A) Full graduate course
(B) Partial graduate course
(C) Undergraduate course

CURRICULA DESIGNATIONS

Curricula given at or commencing at the Naval Postgraduate School:

With the exception of those for the General Line Schools, all curricula given at or commencing at the Naval Postgraduate School are shown below. All are given at the Naval Postgraduate School, Annapolis, unless otherwise indicated. A Group Designation containing the numeral 2 indicates the second year of instruction; the numeral 3 indicates the third year.

Curriculum	Length	Group Designation
AEROLOGY		
Aerological Engineering, Postgraduate School, Monterey	2 yrs.	M, M2
Aerological Eng. (Spec.), Postgraduate School, Monterey	2 yrs.	MS, MS2
Applied Aerology (Spec.)	1 yr.	MA
AERONAUTICS		
Aeronautical Engineering	3 yrs.	A, A2
The third year for general aeronautical engineering is at Univ. of Michigan		A3
Some students specialize in third year as follows:		
Compressibility. Cal. Tech.		AC3
Flight Analysis. Princton.		AF3
Seaplane Hydro dyn. N.Y.U. & Stevens Inst.		AH3
Jet propulsion. Cal. Tech & U. Of Minn.		AJ3
Propulsion Systems. M.I.T.		AP3
Structures. Cal. Tech		AS3
Gas Turbines R.P.I		AT3
Aeronautical Eng. (Electrical)	3 yrs.	AE, AE2, AE3
Aeronautical Eng. (Armament)	3 yrs.	AR, AR2
The third year at M.I.T.		AR3
COMMUNICATIONS		
Communications	1 yr.	C
ELECTRONICS		
Electronic Engineering	3 yrs.	E, E2, E3
Sonar students spend third year at U.C.L.A.		EW3
NAVAL ENGINEERING		
Naval Eng. (Applied)	2 yrs.	NA, NA2
Chemical Engineering	3 yrs.	NC, NC2, NC3
Next group begins in Summer term 1951 and alternate years thereafter. Second and third year at LeHigh.		

Mechanical Engineering	3 yrs.	NH, NH2, NH3
Naval Eng. (gas turbine) The third year at M.I.T.	3 yrs.	NJ, NJ2, NJ3
Electrical Engineering	3 yrs.	NL, NL2, NL3
Metallurgical Eng. Next group begins in Summer term 1951 and alternate years thereafter. Second and third year at Carnegie Tech.	3 yrs.	NM, NM2, NM3
Petroleum Engineering Next group begins in Summer term 1951 and alternate years thereafter. Second and third year at Univ. of Calif.	3 yrs.	NP, NP2, NP3

ORDNANCE

Ordnance Eng. (General) The third year at Purdue	3 yrs.	O, O2, O3
Ordnance Eng. (Fire Control) The second and third years at M.I.T.	3 yrs.	OC, OC2, OC3
Ordnance Eng. (Guided Miss. Control) The third year at Johns Hopkins	3 yrs.	OG, OG2, OG3
Ordnance Eng. (Jet Prop) The third year at Cal. Tech.	3 yrs.	OJ, OJ2, OJ3
Ordnance Eng. (Metallurgy) The third year at Carnegie	3 yrs,	OM, OM2, OM3
Ordnance Eng. (Chemical) The third year at Lehigh	3 yrs.	OP, OP2, OP3
Ordnance Eng. (Electronic) The third year at M.I.T.	3 yrs.	OR, OR2, OR3
Ordnance Eng. (Mech-Elect. Prop.) The third year at M.I.T.	3 yrs.	OT, OT2, OT3
Ordnance Eng. (Subsurface) The third year at U.C.L.A.	3 yrs.	OW, OW2, OW3
Ordnance Eng. (Spec. Physics) The second and third years at M.I.T.	3 yrs.	OX, OX2, OX3

ADVANCED SCIENCE

Advanced Science (Math) The second and third year at a selected University.	3 yrs.	RM, RM2, RM3
Advanced Science (Chem.) The second and third year at a selected University.	3 yrs.	RC, RC2, RC3
Advanced Science (Physics) The second and third year at a selected University.	3 yrs.	RX, RX2, RX3

RADIOLOGICAL DEFENSE

Radiological Defense The second and third year at the Univ. of Calif. or at Ohio State.	3 yrs.	RZ, RZ2, RZ3

OFFICIALS IN CHARGE OF THE PRESENTATION OF CURRICULA OF POSTGRADUATE STUDENT OFFICER GROUPS AT UNIVERSITIES

GROUP		UNIVERSITY	IN CHARGE
A3	Aero. Eng.	Univ. of Michigan	Prof. E. W. Conlon
AF3	Aero. Eng.	Princeton.	Prof. E. C. Perkins
AH3	Aero. Eng.	N.Y.U. & Stevens Inst.	Prof. F. K. Teichmann
AC3			
AJ3	Aero Eng..	Cal. Tech.	Prof. E. E. Sechler
AS3			
AJ3	Aero. Eng.	Univ. of Minn.	Prof. J. D. Ackerman
AP3	Aero. Eng. Prop.Syst.	M.I.T.	Prof. C. F. Taylor
AR3	Aero. Eng. Arm.	M.I.T.	Prof. J. S. Newell
AT3	Aero. Eng. (Gas Turb.)	R.P.I.	Prof. N. P. Bailey
EW3	Electronic Eng.	U.C.L.A.	Prof. V. O. Knudson
NB	Const. Eng.	M.I.T.	P.N.S.
		Webb. Inst.	Capt. N. W. Gokey, USN (Ret.
NC	Chemical Eng.	Lehigh.	Dean H. A. Nevelle
NJ	Gas Turbine	M.I.T.	P.N.S.
NM	Metallurgical Eng.	Carnegie Tech.	Asst. Prof. J. W. Ludewig
NP	Petroleum Eng.	Univ. of Calif.	Prof. L. C. Uren
O3	Ord. Eng. General	Purdue	Prof. H. A. Boltz
OC2,	OC3, Ord. Fire Cons	M.I.T.	Prof. H. L. Hazen
OG3	GM guidance	Johns Hopkins	Prof. W. B. Kouwenhoven
OJ3	Ord. Jet Prop.	Cal. Inst. Tech.	Prof. E. E. Sechler
OM3	Ord. Metallurgy	Carnegie Tech.	Asso. Prof J. W. Ludewig
OP3	Ord. Explosives	Lehigh	Prof. H. A. Neville
OR3	Ord. Elect.	M.M.T.	Prof. E. A. Guillemin
OT3	Ord. Mech-EL Prop.	M.I.T.	Prof. J. C. Hunsaker

GROUP	UNIVERSITY	IN CHARGE
OW3 Ord. Sound	U.C.L.A.	Prof. V. O. Knudson
OX2, OX3 Ord. Sp. Physics	M.I.T.	Prof. N. H. Frank
RZ2, RZ3 Radiological Defense Eng.	Univ. of Calif.	Prof. Loeb
RZ2, RZ3 Radiological Defense Eng.	Ohio State	Prof. Poole
ZCP Cinenotography	Univ. of So. Calif.	P.N.S
ZCR Photo. Tech.	Roch. Inst. Tech.	P.N.S
ZG Civil Eng.	R.P.I.	P.N.S
ZH Law	Catholic U.	Office of JAG
ZH Law	Georgetown U.	" " "
ZH Law	George Washington U.	" " "
ZI Naval Intelligence	Anacostia, D. C.	P.N.S
ZK Advanced Management	Harvard	P.N.S
ZKP Advanced Management	Univ. of Pitts.	Dean V. W. Lanfear
ZKC Business Admin.	Columbia	P.N.S
ZKH Business Admin.	Harvard	P.N.S
ZKS Bus. Admin.	Stanford	P.N.S
ZMB Textile Eng.	Georgia Tech.	P.N.S
ZM Textile Eng.	Lowell Institute	----------
ZO Oceanography	Scripps Inst.	P.N.S
ZP Personnel Admin. & Tr.	Ohio State	P.N.S
ZP Personnel Admin. & Tr.	Stanford	P.N.S
ZT Management & Industry	R.P.I.	P.N.S
ZU Religion	Various	----------

PART II

CURRICULA FOR STUDENT OFFICERS
COMMENCING POSTGRADUATE INSTRUCTION
AT THE POSTGRADUATE SCHOOL, ANNAPOLIS, UNLESS OTHERWISE NOTED

AEROLOGICAL ENGINEERING AND
APPLIED AEROLOGY CURRICULA
AT MONTEREY, CALIFORNIA.

DESCRIPTIVE NAME OF COURSE IS
FOLLOWED BY TWO NUMBERS, SEPARATED
BY A HYPHEN. THE FIRST NUMBER IS
CLASSROOM HOURS, THE SECOND,
LABORATORY HOURS.

AEROLOGICAL ENGINEERING CURRICULUM

M - groups

(Given at Monterey, Calif.)

Objective

To prepare officers:

(a) To become competent aerological officers,

(b) To improve the methods of forecasting weather,

(c) To investigate and participate in the solution of any problems involving atmospheric conditions such as (1) visibility (2) turbulence (3) aircraft icing (4) ballistic winds and densities (5) micro-meteorology, etc.

First Year - M

Summer Term

Ma-101 (C)	Ord. Differential Equations	5-0
Mr-211 (C)	Weather Maps and Codes	2-6
Ph-196 (C)	General Physics	5-1
La-101 (C) 201 (C)	German or Russian	2-0
		14-7

Fall Term

Ma-102 (C)	Series & Vector Algebra	5-0
Mr-212 (C)	Surface Weather Map Analysis	1-12
Mr-210 (C)	Introduction to Synoptic Meteorology	5-0
La-102 (C) 202 (C)	German or Russian	2-0
		13-12

Winter Term

Ma-103 (B)	Funct. of Sev.Var. & Vect. Anal.	5-0
Mr-213 (C)	Map Analysis and Forecasting	0.9
Mr-411 (B)	Thermodynamics of Meteorology	5-2
Mr-510 (C)	Climatology	2-0
La-103 (C) 203 (C)	German or Russian	2-0
SL-101 (C)	New Weapons Development	0-1
		14-12

Spring Term

Ma-134 (A)	Vector Mechanics and Partial Differential Equations	4-0
Mr-214 (C)	Weather Analysis and Forecasting	2-9
Mr-321 (A)	Dynamic Meteorology I	3-0
Mr-412 (A)	Physical Meteorology	3-0
La-104 (C) 204 (C)	German or Russian	2-0
SL-102 (C)	New Weapons Development	0-1
		14-10

Intersessional Field Trip

Second Year - M 2

Summer Term

Ma-135	(C)	Numerical Methods and Introduction to Statistics	4-0
Mr-221	(B)	Weather Analysis and Forecasting	2-9
Mr-228	(A)	Southern Hemisphere and Tropical Meteorology	2-0
Mr-322	(A)	Dynamic Meteorology II	3-0
La-105	(C)	German or Russian	2-0
205	(C)		
			13-9

Fall Term

Ma-331	(A)	Statistics	4-2
Mr-222	(B)	Weather Analysis & Forecasting	0-12
Mr-229	(A)	Selected Topics in Applied Meteorology	2-0
Mr-323	(A)	Dynamic Meteorology III (Turbulence & Diffusion)	3-0
La-106	(C)	German or Russian	2-0
206	(C)		
			11-14

Winter Term

Mr-223	(B)	Advanced Weather analysis and Forecasting	0-9
Mr-410	(C)	Meteorological Instruments	2-2
Mr-420	(A)	Wave, Swell & Surf Forecasting	2-0
Mr-422	(A)	The Upper Atmosphere	5-0
*Mr-921	(A)	Thesis	2-0
La-107	(C)	German or Russian	2-0
207	(C)		
SL-101	(C)	New Weapons Development	0-1
			11/13-12

Spring Term

Mr-110	(C)	Radiological Defense	2-0
Mr-224	(B)	Advanced Weather Analysis and Forecaating	0-15
Mr-225	(B)	Upper Air Analysis	0-10
?Mr-810	(C)	Seminar	2-0
*Mr-922	(A)	Thesis	4-0
La-108	(C)	German or Russian	2-0
208	(C)		
SL-102	(C)	New Weapons Development	0-1
			6/8-26

*Taken only by candidates for the master's degree.

?Omitted by candidates for the master's degree.

APPLIED AEROLOGY CURRICULUM

MA - groups

(Given at Monterey, Calif.)

Objective

To prepare officers to become competent aerological officers.

One Year - MA

Summer Term

Ma-161	(C)	Algebra Trigonometry & Analytic Geometry	5-0
Mr-201	(C)	Weather Maps and Codes	2-12
Mr-200	(C)	Introduction to Synoptic Meteorology	3-0
Ph-190	(C)	Introduction to Physics	3-0
		Total	13-12

Fall Term

Ma-162	(C)	Introduction to Calculus	5-0
Mr-202	(C)	Surface Weather Map Analysis and Forecasting	2-12
Mr-301	(C)	Synoptic Meteorology I	5-0
Mr-402	(C)	Meteorological Charts and Diagrams	3-0
		Total	15-12

Winter Term

Mr-203	(C)	Weather Analysis and Forecasting	2-12
Mr-302	(C)	Synoptic Meteorology II	5-0
Mr-410	(C)	Meteorological Instruments	2-2
Mr-403	(C)	Physical Meteorology	4-0
SL-101	(C)	New Weapons Development	0-1
		Total	13-15

Spring Term

Mr-110	(C)	Radiological Defense	2-0
Mr-204	(C)	Advanced Weather Analysis Forecasting	0-15
Mr-205	(C)	Upper Air Analysis	0-10
Mr-404	(C)	Wave, Swell and Surf Forecasting	1-2
SL-102	(C)	New Weapons Development	0-1
		Total	3-28

SPECIAL AEROLOGICAL ENGINEERING CURRICULUM

MS - Groups

Objective

To permit specially selected aerological officers who have previously completed a short war-time curriculum:

(a) To acquire the necessary theoretical and practical training for advanced work in the field of meteorology.

(b) To acquaint these officers with the latest developments in meteorology and special weapons.

(c) To give these officers an opportunity to qualify for a Master of Science Degree.

Curriculum begins in January

Winter Term

Ma-103 (B)	Funct. of Sev. Var. & Vect. Anal	5-0
Mr-411 (B)	Thermodynamics of Meteorology	5-2
Mr-510 (C)	Climatology	2-0
SL-101 (C)	New Weapons Development	0-1
		12-3

Spring Term

Ma-134 (A)	Vector Mechanics and Partial Differential Equations	4-0
Mr-214 (C)	Weather Analysis and Forecasting	2-9
Mr-321 (A)	Dynamic Meteorology I	3-0
Mr-412 (A)	Physical Meteorology	3-0
SL-102 (C)	New Weapons Development	0-1
		12-10

Second Year

Summer Term

Ma-135 (C)	Numerical Methods & Introduction to Statistics	4-0
Mr-221 (B)	Weather Analysis & Forecasting	2-9
Mr-228 (A)	Southern Hemisphere & Tropical Meteorology	2-0
Mr-322 (A)	Dynamic Meteorology II	3-0
		11-9

Fall Term

Ma-331 (A)	Statistics	4-2
Mr-222 (B)	Weather Analysis & Forecasting	0-12
Mr-229 (B)	Selected Topics in Applied Meteorology	2-0
Mr-323 (A)	Dynamic Meteorology III (Turbulence and Diffusion	3-0
		9-14

Winter Term

Mr-223 (B)	Advanced Weather Analysis & Forecasting	0-9
Mr-420(A)	Wave, Swell and Surf Forecasting	2-0
Mr-422 (A)	The Upper Atmosphere	5-0
Mr-921 (A)	Thesis	2-0
SL-101 (C)	New Weapons Development	0-1
		9-10

Spring Term

Mr-110 (C)	Radiological Defense	2-0
Mr-224 (B)	Advanced Weather Analysis & Forecasting	0-15
Mr-225 (B)	Upper Air Analysis	0-10
Mr-922 (A)	Thesis	4-0
SL-102 (C)	New Weapons Developments	0-1
		6-26

AERONAUTICAL ENGINEERING CURRICULA

Objective

The general objective of the aeronautical engineering curricula is to provide officers with advanced aeronautical engineering knowledge to meet the technical requirements of the Navy in this field. Specifically, these curricula are designed to cover the fundamental and advanced theories of mathematics, mechanics, electricity, metallurgy, structural analysis, aerodynamics and dynamics as they concern the particular field of aeronautical engineering, aeronautical armament, and aeronautical electricity.

AERONAUTICAL ENGINEERING CURRICULUM

Consists of two years of study at the Postgraduate School followed by one year at a civilian engineering school. Satisfactory completion normally leads to the award of a graduate degree in aeronautical engineering. The curriculum is the same for all officers during the first two years but specialization to a limited extent is permitted during the final year's work.. Curricula for the third year at the various civilian institutions are arranged to provide emphasis on such fields as aircraft structural analysis, aircraft propulsion systems, compressibility, pilotless aircraft, aircraft performance, as well as general aeronautical engineering.

Curriculum Designation - "A" for officers entering August 1950

(1) Summer Term		(2) Fall Term	
Ma-101 (C) Intro. to Eng. Math.	5-0	Ae-100 (C) Basic Aerodynamics	3-4
Mc-101 (C) Plane Dynamics I	3-0	Ma-102 (C) Diff.Equations and Serv.	5-0
Mc-001 (C) Statics of Structures	2-0	Mc-102 (C) Plane Dynamics II	3-0
Ch-121 (B) Genl.and Petroleum Chemistry	4-2	ME- 500 (C) Strength of Materials	3-0
		ME-601 (C) Materials Testing	0-2
Mt-201 (C) Introd. Phys. Metallurgy	3-2	Mt-202 (C) Ferrous Metals	3-2
		Ae-001 (C) Lecture-Aeron.	-
	17-4		17-8

(3) Winter Term		(4) Spring Term	
Ae-121 (C) Technical Aerodyn.	3-2	Ae-131 (C) Aerody. Perform.	4-2
Ae-201 (C) Airc.Stress Analysis	4-2	Ae-202 (C) Airc.Stress Ana. II	4-2
Ma-103 (B) Funct. of Sev. Var.& Vect.	5-0	EE-231 (C) AC Circuits-DC Mach.	3-2
		Ma-104 (A) Part.Diff.Equations	5-0
EE-111 (C) Fundamtls.of Elect Eng	3-2	Ma-201 (C) Graph. & Mech. Comp.	0-2
Mt-203 (B) Phys. Metallurgy	2-2	SL-102 Lecture-New Weap.	
SL-101 Lecture-New Weapons			
	17-8		16-8

Summer, June-July 1951 - Six weeks.

Intersessional period in the field at aviation activities.

Second Year

For group entering July 1949

Curriculum Desingation - "A2"

(5) Summer Term

Ae-203	(A)	Airc. Stress Analysis III	4-0
Ae-311	(C)	Aircraft Design I	2-4
Ae-501	(A)	Hydro - Aero. Mech. I	4-0
ME-131	(C)	Eng. Thermo.	4-2
EE-731	(C)	Power Electronics	3-2
			17-8

(6) Fall Term

Ae-132	(B)	Flight Analysis	3-2
Ae-204	(A)	Stress Analysis IV	4-0
Ae-312	(B)	Airplane Design II	2-4
Ae-502	(A)	Hdro-Aero Mech. II	4-0
ME-132	(C)	Eng Thermo.	3-2
Ae-001	(C)	Lecture-Aero.	
IE-101		Lecture-Indus. Org.	
			16-8

(7) Winter Term

Ae-503	(A)	Compressibility	4-0
Ae-141	(A)	Aircraft Dynamics I	3-4
Ae-321	(A)	Adv Aircraft. Struct.	4-0
Ae-411	(B)	Aircraft Eng.	3-2
Ch-521	(A)	Chemistry Plastics	3-2
SL-101		Lecture-New Weap. Dev.	
IE-103		Lecture-Indust. Org.	17-8

(8) Spring Term

Ae-142	(A)	Airc. Dynamics II	3-4
Ae-421	(B)	Airc. Propuls.	3-2
Mc-311	(A)	Vibrations	3-2
*ME-632	(B)	Exper. Stress Anal.	2-2
Ae-431	(A)	Int. Flow in Aircraft Eng.	4-0
SL-102		Lecture New Weap.	
			15-10

*Propulsion group takes Ch-561 (A) Physical Chemistry (3-2) in place of ME-632 (B) this term.

Summer Period spent in a civilian institution summer course in industrial engineering.

Third and last year aeronautical engineering will be conducted by a civilian institution. See third Year aeronautical engineering curricula.

Aeronautical Engineering (Armament)

Curriculum

This curriculum consists of two years of study at the Postgraduate School followed by one year at the Massachusetts Institute of Technology. Satisfactory completion of this curriculum normally leads to the award of a graduate degree. This curriculum is designed to cover electrical, aeronautical and mechanical engineering subjects and related mathematics, metallurgy, electronics and ordnance courses. The third year at M.I.T. majors in guided missile electronic controls, and fire control systems.

Curriculum Designation "AR". For officers entering August 1950

(1) Summer Term			(2) Fall Term		
EE-151 (C)	D.C.Circuits & Fields	3-4	EE-251 (C)	A.C.Circuits	3-4
Ma-101 (C)	Introd. to Eng. Math.	5-0	Ma-102 (C)	Differential Eqs. & Sev.	5-0
Mc-101 (C)	Plane Dynamics I	3-0	Mc-102 (C)	Plane Dynamics II	3-0
Mc-801 (C)	Statics of Structures	2-0	ME-500 (C)	Strgth of Materials	3-0
Ch-101 (C)	Chem. General Inorganic	3-2	Ae-100 (C)	Basic Aerodyn.	3-4
			Ae-001 (C)	Lecture Aeron.	
		16-6			17-8

(3) Winter Term			(4) Spring Term		
EE-451 (C)	Transformers & Synchros	2-2	EE-455 (C)	Asyn. Motors	2-2
Ma-103 (B)	Functs of Sev. Var.	5-0	Ma-104 (A)	Part. Diff.Eq's.	5-0
Mt-201 (C)	Phys.Metallurgy-Intro.	3-2	Mt-202 (C)	Phys.Metal.Ferrous	3-2
Ae-201 (C)	Stress Analysis I	4-2	Ae-202 (C)	Aero.Stress Anal.II	4-2
Ae-121 (C)	Technical Aerodyn.	3-2	Ae-136 (B)	Aircraft Perform.	3-2
SL-101	Lecture New weap.Dev.		SL-102	Lecture New weap.	
		17-8			17-8

Six weeks intersessional period in the field.

Second Year

For group entering July 1949.

Curriculum Designation "AR2"

(5) Summer Term				(6) Fall Term			
EE-551 (B)	Transm.Lines & Filtrs.	3-2		EE-755 (A)	Electronic Control & Measurement	3-4	
Ma-155 (A)	Matric. & Calc. of Variations	3-0		Mc-401 (A)	Ext. Ballistics	3-0	
EE-751 (C)	Electronics	3-4		Ma-401 (A)	Mechan.Computers	2-2	
Ae-311 (C)	Aircraft Design	2-4		Ma-106 (A)	Comp.Var.& LaPlace Tr.	4-0	
Ae-501 (A)	Hydro-Aero Mech. I	4-0		Ae-502 (A)	Hydro-Aero Mech.II	4-0	
			15-10	IE-101	Lecture-Indus.Org.		
				Ae-001 (C)	Lecture-Aeron.		
							16-6

(7) Winter Term				(8) Spring Term			
EE-671 (A)	Transients	3-4		EE-753 (C)	Electronics	1-2	
Mc-402 (A)	Dyn.of Miss.& Gyros	3-0		EE-672 (A)	Servo-Mechanisms	3-4	
Or-141 (C)	Guid.Miss.Guidance	2-0		Es-456	Introd to Radar (Airborn)	2-2	
Ae-503 (A)	Compressibility	4-0		Mt-203 (B)	Physical Metallurgy	2-2	
Ae-146 (A)	Airc. Dynamics	3-2		Mc-201 (A)	Methods in Dynamics	2-2	
SL-101	Lecture-New Weap.Dev.			Or-142 (C)	Guid.Missl.Guidance	1-0	
IE-103	Lecture-Indus. Org.			SL-102	Lecture New Weap.Dev.		
			15-6				11-12

Summer period between 2nd and 3rd years will be spent at a naval aviation activity.

Third Year at M.I.T.

AERONAUTICAL ENGINEERING (ELECTRICAL) CURRICULUM

This curriculum consists of three years at the Postgraduate School. Satisfactory completion normally leads to the award of a graduate degree in electrical engineering. The curriculum is designed to provide major emphasis on electricity and is supported by aeronautics, mathematics, metallurgy, electronics and mechanics. The objective of this curriculum is to provide electrical engineers with a good understanding of aeronautical engineering.

Curriculum Designation "AE"

For officers entering August 1950.

"AE"

(1) Summer Term

Ma-101	(C)	Ord.Diff.Equatn's.	5-0
EE-171	(C)	Elect.Circts.& Flds.	3-4
Mc-101	(C)	Plane Dynamics I	3-0
Mc-801	(C)	Statics of Structures	2-0
Ch-101	(C)	Chem.General Inorganic	3-2
			16-6

(2) Fall Term

Ma-102	(C)	Series & Vec.Algebra	5-0
EE-271	(C)	AC Circuits	3-2
Mc-102	(C)	Plane Dynamics II	3-0
ME-500	(C)	Strgth-Materials	3-0
Ae-100	(C)	Basic Aerodyn.	3-4
Ae-001	(C)	lect. Aeron.	
IE-101		Lect. Ind. Org.	
			17-6

(3) Winter Term

Ma-103	(B)	Funct.Sev.Var. & Vects.	5-0
EE-272	(C)	AC Circuits	2-2
Mt-201	(C)	Phys.Metall.Introd.	3-2
Ae-201	(C)	Aeron.Stress Anal. I	4-2
Ae-121	(C)	Tech.Aerod.I	3-2
SL-101		Lect.New Weap. Dev.	
			17-8

(4) Spring Term

Ma-104	(A)	Part.Diff. Eqts.	5-0
EE-371	(C)	D.C. Mach.	3-2
Mt-202	(C)	Phys.Metall.-Ferrous	3-2
Ae-202	(C)	Aeron.Stress.Anal.II	4-2
Ae-136	(B)	Airc Perform.	3-2
SL-102		Lect.New Weap. Dev.	
			18-8

Six weeks intersessional period in the field at an aviation test activity.

Second Year

Curriculum Designation "AE2"

For officers entering July 1949.

(5) Summer Term			(6) Fall Term		
Ma-105 (A)	Fourier Series & B.L. Prob.	4-0	Ma-106 (A)	Comp.Var.& LaPlace Trans	4-0
EE-471 (C)	Transfrmrs.,Asymchro. & Synchro. Mach.	3-4	EE-472 (C)	Syn. Machines	3-4
Ae-311 (C)	Aircraft Design	2-4	EE-971 (A)	Elect. Semin.	1-0
Ae-203 (A)	Airc.Stress Anal. III	4-0	Ch-521 (A)	Chem. Plastics	3-2
Ae-501 (A)	Hydro.Aero.Mech. I	4-0	Ae-502 (A)	Hydro.Aero.Mech. II	4-0
			IE-101	Lect. Ind. Org.	
			Ae-001 (C)	Lect. Aeron.	
		17-8			15-6

(7) Winter Term			(8) Spring Term		
EE-571 (B)	Transm.Lines & Filtrs.	3-4	EE-772 (B)	Electronics	3-2
EE-771 (B)	Electronics	3-2	EE-971 (A)	Elect. Semin.	1-0
EE-971 (A)	Elect. Seminar	1-0	Es-226 a	Pulse Circuits	2-1
Es-256 (C)	Introduction to Radar App. of Vac. Tubes	2-0	Mt-203 (B)	Physical Metallurgy	2-2
Ae-503 (A)	Compressibility	4-0	Mc-201 (A)	Methods Dynamics	2-2
Ae-146 (A)	Aircraft Dynam.	3-2	Ma-201 (C)	Graph.& Mech.Comp.	0-2
SL-101	Lect.New Weap. Dev.		IE-104	Lect.Indust.Organ.	
IE-103	Lect.Indust. Org.		Sl-101	Lect.New Weap. Dev.	
		16-8			10-9

Intersessional period of four weeks in an electrical test activity.

Third Year

At Postgraduate School for officers entering July 1948. Curriculum designation "AE3"

(9) Summer Term			(10) Fall Term		
EE-671 (A)	Transients	3-4	EE-672 (A)	Servo.Mechanisms	3-4
EE-871 (A)	Electrical Machine Design	4-0	EE-872 (A)	Elect.Mach. Des.	4-0
Es-431 (B)	Radar System Eng.	3-3	EE-971 (A)	Elect.Semin.	1-0
	Thesis	0-6	Es-432 (B)	Radar System Eng.	3-6
			Ae-002	Aeron. Lecture	0-2
				Thesis	0-3
		10-13			11-15

(11) Winter Term			(12) Spring Term		
Es-321 (B)	Radio Systems Des.	3-3	EE-971 (A)	Elect. Sem.	1-0
EE 873 (A)	Elect.Mach. Des.	4-0	Es-536	Counter measures	2-3
EE-971 (A)	Elect. Seminar	1-0		Thesis	-10
Ie-103	Lecture-Indust. Org.				
	Thesis	0-10			3-13
		8-13			

FOR 1950-1951 ACADEMIC SCHOOL YEAR

AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Aircraft Propulsion Systems AP3

Fall Term		Spring Term	
2.213	Gas Turbines	2.214	Gas Turbines
2.791	Internal Comb. Engs.	2.792	Intern. Comb. Engines
10.70	Principles of Combust.	16.56	Jet Engines
16.105	Applied Aerodynamics		Thesis
	Thesis		

AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Aircraft Armament AR3

Fall Term		Spring Term	
16.40	Space Kin.& Gyro Theory	16.44	Fire Control Instrmts Adv.
16.15	Stability & Cont. of Airc.	16.46	Fire Control Instrmt Lab.
16.41	Introd, to Fire Control		Thesis
16.43	Fire Cont. Instr. Lab.		
16.39	Autom. Control Equip.		
	Thesis		

COMBINED CURRICULUM AT NEW YORK UNIV. & STEVENS INSTITUTE

AERONAUTICAL ENGINEERING-SEAPLANE HYDRODYNAMICS-AH3

Fall Term		Spring Term	
FD 203	Mechanics of Fluid Resist.	FD 209	Applied Hydrodynamics
FD 215	Seaplane Design	AE 226	Avia. Gas Turbines
PH 57	Advcd Thermodynamics	FD 210	Experm. Methods in Hydrod.
AE 201c	Theoretical Aerodynamics	FD 211	Dyn. of Bodies in Fluids
AE 225	Aircraft Gas Turbines	FD 216	Seaplane Design
	Thesis	AE 210	Aircraft Stress Analysis
			Thesis

AT PRINCETON UNIVERSITY

AIRCRAFT FLIGHT PERFORMANCE - AF3

Fall Term		Spring Term	
AE-565	Airplane Dynamics	AE-566	Airplane Dynamics
AE-583	Advcd. Airpln Performance	AE-570	Analytcl Methods in Eng.
AE-563	Jet Propulsion	AE-528	Servo Mechanisms
AE-569	Analytical Methods in Eng.	AE-700	Spec. Probs in Airc. Perf.
	Thesis		Thesis

AT RENSSELAER POLYTECHNIC INSTITUTE

GAS TURBINE PROPULSION SYSTEMS - AT3

Fall Term		Spring Term	
G12.30	Thermo. of Hi-Veloc. Flow	G12.41	Turbines & Jets Cycles
G12.40	Gas Turb. Comb. & Stability	G1.13	Dynamics & Stab. of Airc.
G4.52	Chem. of Combustion	G16.67	Nuclear Physics
G13.62	Hi-temp Metallurgy	G12.99	Thesis
G1.17	Comprs. & Incomprs Flow		

AT CALIFORNIA INSTITUTE OF TECHNOLOGY

JET PROPULSION AJ3

AE 261 Hydrodynmc of Compr. Fluids
AE 272 Precision Measurmts
AE 290 Aeronautics Seminar
JP 121 Rockets
JP 130 Thermal Jets
JP 170 Jet Propulsion Lab.
JP 210 HiTemp. Design Probs.
JP 280 Research in Jets.
JP 200 Chemistry Probs in Jets.

COMPRESSIBILITY AC3

AE 260 Research in Aero.
AE 261 Hydro. of Comp. Fluids
AE 266 Theor. Aerodyn. of Fluids
AE 270 Elasticity of Aeronautics
AE 272 Precision Measurements
AE 290 Aeronautics Seminar
AM 150 Vibration & Flutter

STRUCTURES AS3

AE 254 Advcd Probs in Airplane Design
AE 257 Engineering Mathematical Princs.
AE 260 Research in Aeronautics
AE 270 Elasticity Applied to Aeronautics
AE 272 Precision Measurements
AE 274 Problems in Aero-elasticity
AE 290 Aeronautics Seminar
AM 150 Vibration & Flutter

AT THE UNIVERSITY OF MICHIGAN

AERONAUTICAL ENGINEERING GENERAL-A3

Fall Term

Ae-116 Advcd Fluid Dynamics
Ae-172 Instrumentation & Research
*Ae-118 Experim. Aerodynamics
*Ae-174 Atomic Physics
*Ae-105 Dynamic Stability
*EM-123 Theory of Strength
*MA-152 Math.-Fourier Series
Thesis

Spring Term

*AE-102 Advanced Design
*AE-133 Advcd Airpln Structures
*AE-160-1 Introd. to non-linear Sys.
AE-160-2 Symposium-Propulsion
AE-162 Thesis
*AE-165 Airc. Propulsion I
*AE-171 Airc. Servo Cont. Systems
*AE-202 Dynmcs. Compress. Fluids
*AE-203 Dynmcs. Perfect Fluids
*AE-204 Aircft. Propulsion II
*EM-129 Plasticity

* Elective courses.

AT THE UNIVERSITY OF MINNESOTA

JET PROPULSION * AJ3

Fall Term

AE 116 Advcd. Airpln. Stresses
AE 201 Aerodn. Comprs. Fluids
ME 252 Advcd. Reciproc. Engs.
Thesis

Winter Term

AE 117 Advcd. Airpl. Stresses
AE 202 Compress. Fluids
ME 253 Advcd. Gas Turbines
Thesis

Spring Term

AE 118 Stresses in Aircraft Structures
AE 204 Supersonic Aerodynamics Lab.
ME 255 Thermal Jets & Rockets
Thesis

COMMUNICATIONS-C-

Objective

To prepare selected officers of the Navy:

(a) By a thorough operational knowledge of communications, to assist the Naval Communication Service in its function as an indispensable accessory of Command.

(b) To be competent tactical officers, and to better perform duties of the Line.

(c) To be competent supervisors over the service operation of all types of apparatus utilized by the Naval Communication Service.

(d) To perform various administrative duties of the Naval Communication Service.

Summer Term

Co-101 (C)	Typing & Radio Code	0-4
Co-110 (C)	Communication Procedure	2-2
Co-120 (C)	Comm. Org. & Secur	2-1
Co-131 (C)	Tactics	2-2
Co-135 (C)	Corr. Course in Strategy & Tactics	-
Es-186 (C)	Fund.of Radio Comm.	4-4
Es-281 (C)	Electronics Fund.	2-2
		11-16

Fall Term

Co-102 (C)	Radio Code & Procedure	0-4
Co-111 (C)	Teletype, Append. to Comm. Inst.	2-2
Co-121 (C)	Basic Rapid Comm.Plan	2-1
Co-132 (C)	Tactics	2-2
Co-135 (C)	Corr. Course in Strategy & Tactics	-
Es-282 (C)	Vacuum Tube Circuits	4-4
Es-786 (C)	R.F. Energy Trans.	3-2
		13-15

Winter Term

Co-103 (C)	Visual & Voice Proc.	0-3
Co-112 (C)	Intern. & Comm. Comm.	1-1
Co-122 (C)	Basic Rapid Comm. Plans; Type & Task Force Comm. Plan	2-3
Co-133 (C)	Tactics	2-2
Co-135 (C)	Corr.Course in Strategy & Tactics	-
Es-283 (C)	Vacuum Tube Circuits	4-3
Es-286 (C)	Pulsing & H.F. Circuits	3-2
SL-101 (C)	New Weapon Develop.	**0-1
		12-15

Spring Term

Co-104 (C)	Comm & Other Nav. Organ.	2-1
Co-113 (C)	Correspondence & Mail	1-0
Co-114 (C)	Crypto Systems Instruc.	0-2
Co-123 (C)	Amphibious Comm.Plan	1-3
Co-134 (C)	Tactics	2-2
Co-135 (C)	Corr.Course in Strategy & Tactics	-
Es-386 (C)	Trans. & Receivers	3-3
Es-586 (C)	Special Systems	3-3
SL-101 (C)	New Weapon Develop.	**0-1
		12-15

**Lecture course.

ELECTRONICS ENGINEERING

Objective

To give the student a thorough practical and theoretical training in electronics engineering in preparation for future duties involving the development and use of electronics equipment and system in the Naval Establishment.

FIRST YEAR (E1)

Summer Term

Ma-101	(C)	Intro. to Eng. Math.	5-0
Es-111	(C)	Electricity (D.C.)	4-4
Es-211	(C)	Electron Tubes & Circuits	2-3
Ph-211	(C)	Geom. & Phys. Optics	3-0
			14-7

Fall Term

Ma-102	(C)	D.A.Equations & Series	5-0
Es-112	(C)	Electricity (A.C.)	4-3
Es-212	(C)	Electron Tubes & Circuits	2-3
Ph-212	(B)	Phys. Optics & Dynamics	3-3
IE-101	(C)	Industrial Engineering	0-1
			14-10

Winter Term

Ma-103	(B)	Funct.of Sev.Var & Vect. Anal.	5-0
Es-113	(C)	Circuit Analysis & Meas.	3-3
Es-213	(C)	Electron Tubes & Cir.	4-4
Ph-113	(B)	Dynamics	3-0
SL-101	(C)	New Weapons	0-1
IE-103	(C)	Industrial Engineering	0-1
			15-8

Spring Term

Ma-104	(A)	Part. Diff. Eq. & Rel. Topics	5-0
Es-114	(C)	Circuit Analysis & Meas.	3-3
Es-214	(C)	Electron Tubes & Cir.	4-3
Ph-311	(A)	Electrostatics & Magnetostatics	3-0
SL-102	(C)	New Weapons	0-1
IE-104	(C)	Human Engineering	0-1
			15-8

Second Year (E2)

Summer Term

Es-621	(A)	Electromagnetics	3-0
EE-314	(C)	A.C. & D.C.Machines	3-4
Ph-421	(A)	Fundamental Acoustics	3-0
Es-225	(A)	Electron Tubes	3-6
			12- 10

Fall Term

Es-622	(A)	Electromagnetics	4-0
EE-672	(A)	Servomechanisms	3-4
Ph-422	(A)	Applied Acoustics	3-0
Es-126	(C)	Radio Freq. Measurements	2-6
			12-10

SECOND YEAR (E2) (Cont'd.)

Winter Term		Spring Term	
Es-623 (A) Electromagnetics	4-0	Es-624 (A) Electromagnetics	3-0
Es-121 (A) Adv.Circuit Theory	3-2	Es-122 (A) Adv.Circuit Theory	3-2
Ph-423 (A) Underwater Acoustics	2-3	Es-226 (A) U.H.F. Tubes	4-3
Es-321 (B) Radio Systems	3-3	Es-322 (B) Radio Systems	3-3
	12-8		13-8

THIRD YEAR (E3)

Summer Term		Fall Term	
Es-736 (B) Antennas,Trans.Lines	3-3	Es-531 (B) Special Systems	3-3
Es-133 (A) Adv.Circuit Theory	3-0	Es-134 (A) Adv.Circuit Theory	3-0
Es-431 (B) Radar System Eng.	3-3	Es-432 (B) Radar System Eng.	3-6
Es-333 (B) Radio Systems	2-3	Es-831 (A) Thesis Seminar	2-0
	11-9		11-9

Winter Term	Spring Term	
This term is spent in an industrial electronics laboratory, such as Bell Telephone Co., R.C.A., or General Electric Co. During this period the student works as a junior engineer or physicist on a selected project which forms part of, or is related to, his thesis	Es-532 (B) Special Systems	3-3
	Es-036 (C) Electronics Admin.	2-0
	Es-832 (A) Thesis Seminar	4-0
	Es-836 (A) Project Seminar	1-0
	Ph-631 (A) Atomic Physics	4-0
		14-3

ELECTRONICS ENGINEERING (SONAR)

Objective

To give the student a thorough practical and theoretical training in electronics engineering and acoustics in preparation for future duties involving the development and use of underwater electronics equipment and systems in the Naval Establishment.

FIRST YEAR (E1)

Follow ((E1) curriculum.

SECOND YEAR (E2)

Follow (E2) curriculum excepting for substitution of
Ph-424 (A) Sonar Systems and Developments.
For Es-322 (B) Radio Systems

THIRD YEAR (EW3)

at University of California at Los Angeles

Fall Term	Spring Term
Phys 214 Advanced Acoustics	Phys 266 Propagation of Waves in Fluids
Phys 220A Theoretical Mechanics	Phys 264 Advanced Acoustics Seminar
Phys 114C Acoustics Laboratory	Phys 290 Acoustics Research
Phys 124 Nuclear Structure	Phys 117 Hydrodynamics
	Phys 119 Kinetic Theory

PHYSICS CURRICULUM

Objective

The objective of this curriculum is to prepare officers for duties in connection with the application of Physics to such types of fundamental research and development as may be required by the National Military Establishment. Only students having the necessary qualifications will be admitted to this curriculum.

FIRST YEAR (Ph1)

	Summer Term			Fall Term	
Ph-240(C)	Geom. and Phys. Optics	3-3	Ph-141(B)	Analytical Mechanics	4-0
Ch-102(C)	Gen. Inorganic Chem.	4-2	Ph-241(B)	Polarized Light	1-3
Ma-181(C)	Partial Deriv. and Ord. Diff. Eqs.	5-0	Ph-341(C)	Elect and Magnetism	4-2
		12-5	Ma-182(B)	Vector Analysis	5-0
					14-5
	Winter Term			**Spring Term**	
Ph-142(B)	Analytical Mechanics	4-0	Ph-343(B)	Elect and Magnetism	3-0
Ph-342(B)	Elect. and Magnetism	3-3	Ph-640(B)	Atomic Physics	3-3
Ma-183(B)	Complex Variables	5-0	Ma-184(A)	Special Math. Methods of Physics.	5-0
		12-3			11-3

SECOND YEAR (Ph2)

	Summer Term			Fall Term	
Ph-361(A)	Electromagnetism	3-0	Ph-143(A)	Advanced Mechanics	3-0
Ph-421(A)	Acoustics	3-0	Ph-540(B)	Kin. Theory of Gases	3-0
Ph-426(B)	Acoustics Lab.	0-3	Ch-442(C)	Physical Chemistry#	4-2
Ph-530(B)	Physical Thermodynamics	3-0		Thesis*	
	Thesis*	9-3			10-2

#May be taken during some other term if not available at this time.

	Winter Term			Spring Term
Ph-721(A)	Intro. to Quan. Mech.	4-0		Elective**
	Elective**			Elective**
	Thesis*			Thesis*

* The student will choose a thesis topic with the approval of the staff. The research involved may be either experimental or theoretical.

** Elective courses may be selected from advanced courses in the Physics Department or in other departments in the Postgraduate School, subject to the needs of the individual student. Possible courses would include Theoretical Physics, Nuclear Physics, Theory of Solids, Statistical Mechanics, Spectroscopy, X-rays and Crystallography, Theory of Metals, Mathematics and Chemistry.

NAVAL ENGINEERING CURRICULUM

Applied Curriculum - NA Groups

Objective

The general objective of this curriculum is to develop officers competent to:

(a) Direct the inspection, installation, operation and maintenance of naval machinery and equipment (excepting radio and sound equipment) over which the Bureau of Ships has cognizance, or for which the Engineering Officer afloat is held responsible by the U.S.Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineering officers of all types of naval vessels and staff engineers afloat.

(b) Maintenance and Repair assignments in the Bureau of Ships, on repair ships, at navy yards, and repair bases.

(c) Inspectors of Naval Machinery and Material.

First Year (NA)

Summer Term

Ma-171(C)	Special Topics in Calc.	3-0
Ma-201(C)	Graph.& Mech. Comp.	0-2
Mc-101(C)	Plane Dynamics I	3-0
Ch-101(C)	Gen. Chemistry	3-2
EE-151(C)	D.C.Circuits & Fields	3-4
	Total	12-9

Fall Term

Ph-610(B)	Atomic Physics	3-0
Ma-172(C)	Fourier Series & Rel. Topics.	3-0
Mc-102(C)	Plane Dynamics II	3-0
Mt-201(C)	Physical Met.	3-2
EE-251(C)	AC Circuits	3-4
	Total	15-6

Winter Term

Ma-173(B)	Funct.of Var.Intro.to Vec.	3-0
Mt-202(C)	Phys.Met.(Ferrous)	3-2
Ch-521(A)	Plastics	3-2
Ch-111(A)	Fuel & Oil Chem.	2-2
EE-351(C)	DC Machinery	2-2
	Total	13-8

Spring Term

Ma-174(B)	Intro to Laplace Trans.,related Topics	3-0
ME-700(C)	Kin. of Mach.	3-2
Mt-203(B)	Phy. Metallurgy	2-2
EE-451(C)	Transformers & Synchros.	2-2
ME-111(C)	Thermodynamics	4-2
	Total	14-8

Intersessional Field Trip.

Second Year (NA2)

Summer Term			Fall Term		
EE-452(C)	Syn.Mach.& Induc.Motors	3-4	ME-830(C)	Mach. Design	4-2
ME-122(C)	Thermodynamics	3-2	EE-751(C)	Electronics	3-4
ME-520(C)	Str. of Materials	5-0	ME-221(C)	Mar.P.P. Equip.	3-2
ME-601(C)	Materials Testing Lab.	0-2	ME-421(C)	Hydro-Dynamics	3-2
Mt-301(A)	High Temp Materials	3-0	IE-101(C)	Industrial Eng.	0-1
	Total	14-8		Total	13-11

Winter Term			Spring Term		
EE-551(B)	Trans.Lines & Filters	3-2	ME-217(C)	Int.Comb.Eng.(Diesel)	4-2
ME-222(C)	Mar. P.P. Equip.	3-4	EE-651(B)	Transients & Servos	3-4
NE-101(C)	Marine Eng.(Main Prop)	3-0	ME-224(B)	Mar. P.P. Anal.	0-6
*IE-103(C)	Industrial Eng.	0-1	NE-102(C)	Marine Eng.(Aux.Mach.)	3-0
*SL-101	New Weapons	0-1	NE-103(C)	Marine Eng.(Dept Org.)	1-0
ME-422(C)	Hydro-Equip.	2-2	*IE-104(C)	Human Eng.	0-1
ME-223(C)	Mar. P.P. Analysis	2-0	*SL-102	New Weapons	0-1
	Total	13-10		Total	11-14

*Lecture course.

NAVAL ENGINEERING

Chemical Curriculum - NC Groups

Objective

The objective of this curriculum is to provide the training necessary for a selected group of officers to:

(a) Supervise and direct activities at the Standards Branch, Bureau of Ships involving Chemical processes.

(b) To act in an advisory capacity with civilian establishments in the development and production of materials for the naval service.

(c) To be able to appreciate developments in industry involving materials other than metals, such as paints, protective coatings, plastics, etc., and advise the Bureau of Ships as to the suitability of such developments in solving problems of maintenance and repair.

First Year (NC)

(Next group begins in 1951 Then alternate years)

Summer Term			Fall Term		
Ma-171(C)	Special Topics in Calc	3-0	Ma-172(C)	Fourier Series & Rel. Topics	3-0
Ma-201(C)	Graph.& Mech. Comp	0-2	Ch-221(C)	Qualitative Analysis	3-2
Mc-101(C)	Statics & Kinematics	3-0	Ch-521(A)	Plastics (Eng.Materials)	3-2
Ch-101(C)	General Chemistry	3-2	Mt-201(C)	Physical Metallurgy	3-2
†EE-	Elect. Eng.	3-4	Ch-611(C)	Thermodynamics	3-2
	Total	12-8		Total	15-8

*Chemical Curriculum under revision.

†Under revision.

NAVAL ENGINEERING - Chemical Curriculum - NC Groups (Cont'd)

Winter Term			Spring Term		
Ma-173(B)	Funct. of Sev. Var. & Intro. Vect.	3-0	Ch-701(C)	Chem.Eng.Calculations	3-2
Mt-202(C)	Phys.Metal.(Ferrous)	3-2	Ch-412(C)	Physical Chemistry	2-2
Ch-411(C)	Physical Chemistry	3-2	Ch-612(C)	Thermodynamics(Chem)	3-2
*SL-101	New Weapons	0-1	Mt-203(B)	Phys. Met.	2-2
Ch-322(A)	Adv. Org. Chem.	3-2	*SL-102	New Weapons	0-1
ME-500(C)	Strength of Materials	3-0	Cr-271(B)	Crystallography & X-ray	3-2
ME-601(C)	Mat.Test.& Str.Anal.	0-2			13-11
		15-9			

Intersessional Field Trip

Second Year (NC2)

at Lehigh University

(See Lehigh U. Catalogue)

First Term	Second Term
Chem. 150 Org. Chem.	Chem. 151 Org. Chem
Chem. 165 Org. Chem. Lab.	Chem. 167 Org. Chem. Lab.
Chem. 190 Phys. Chem.	Chem. 194 Phys. & El. Chem
Chem 192 Phys. Chem. Lab.	Chem. 197 El. Chem. Lab.
Ch.E. 78 Chem. Engr.	Ch.E. 79 Chem. Engr.
	Ch.E. 180 Chem. Engr.

Intersessional Field Trip and Chem. Engr. Research.

Third Year (NC3)

at Lehigh University

First Term	Second Term
Ch.E. 181 Chem. Engr.	Ch.E. 283 Chem. Engr.
Ch.E. 282 Chem. Engr.	Ch.E. 281 Chem. Engr. Res.
Ch.E. 183 Unit Proc.	Ch.E. 185 Chem. Engr. Prac.
Ch.E. 280 Chem. Engr. Res.	Chem. 221 Adv. Phys. Chem.
Chem. 220 Adv. Phys. Chem.	Ch-E. 286 Ch.E. Proc. Contr.

NAVAL ENGINEERING

Mechanical Curriculum - NH Groups

Objective

The object of this Curriculum is to develop officers competent to direct the inspection, installation, and maintenance of Naval Machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by U. S. Naval Regulations

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officer of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance devisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory

(e) Inspectors of Naval Machinery and Material.

Third Year (NH3)

(1948-1951 Group)

Summer Term			Fall Term		
ME-212(C)	Mar. Power Plant Equip.	3-4	ME-215(B)	Mar. P.P. Analysis	2-4
ME-612(A)	Exp. Stress Analysis	3-2	NE-101(C)	Naval Eng. Main Prop.	3-0
ME-811(C)	Machine Design	3-2	ME-812(B)	Mach. Design, Cont'd.	3-4
Mt-301(A)	High Temp. Materials	2-2	ME-217(C)	Comb. Eng.	4-2
	Total	11-10		Total	12-10

Winter Term			Spring Term		
ME-216(A)	Mar. P.P. Design	2-4	NE-102(C)	Nav. Eng. Auxiliaries	3-0
EE-651(B)	Transients and Servos	3-4	NE-103(C)	Eng. Dept. & Org.	1-0
	Thesis	2-10		Thesis	2-20
	Total	7-18		Total	6-20

Second Year (NH2)

(1949-1952 Group - Transitional)

Summer Term			Fall Term		
ME-112(B)	Thermodynamics	4-2	ME-211(C)	Mar. P.P Equip.	3-2
Mt-203(B)	Phys. Met.	2-2	ME-711(C)	Mech. of Mach	3-2
EE-452(C)	Synch.Mach. & Induct		ME-712(A)	Dynamics of Mach.	3-2
	Motors	3-4	EE-751(C)	Electronics	3-4
Ch-561(A)	Phys Chem.	3-2	IE-101(C)	Ind Org	0-1
	Total	12-10		Total	12-11

Winter Term			Spring Term		
ME-212(C)	Mar. P.P Equip.	3-4	ME-215(B)	Mar. P.P Anal.	2-4
ME-511(C)	Str. of Materials	5-0	ME-512(A)	Str. of Materials	5-0
EE-651(B)	Trans. & Servos	3-4	ME-611(C)	Mat. Test. Lab.	2-2
IE-103(C)	Ind Org.	0-1	ME-310(B)	Heat Transfer	3-2
SL-101	New Weapons	0-1	IE-104(C)	Human Eng.	0-1
			-102	New Weapons	0-1
	Total	11-10		Total	12-10

Intersessional Field Trips.

Third Year (NH3)

(1949-1952 Group - Transitional)

Summer Term			Fall TErm		
ME-216(A)	Mar. P P Design	2-4	Mt-301(A)	High Temp Mat.	3-0
ME-513(A)	Theory of Elast.	3-0	ME-612(A)	Exp Stress Anal.	3-2
ME-411(C)	Hydrodynamics	3-2	ME-412(A)	Hydrodynamics	4-2
ME-811(C)	Mach. Design	3-2	ME-812(B)	Adv. Mach Design	3-4
	Total	11-8		Total	13-8

Winter Term			Spring Term		
NE-101(C)	Nav.Eng.Main Prop	3-0	NE-102(C)	Naval Eng Aux	3-0
ME-217(C)	Int. Comb. Eng.	4-2	NE-103(C)	Eng Dept & Org.	1-0
Ae-431(A)	Turb. & Comp.	4-0		Thesis	2-20
	Thesis	2-8			
				Total	6-20
	Total	13-10			

First Year (NH)

(1950-1953 Group)

Summer Term			Fall Term		
Ma-101(C)	Intro.to Eng. Math.	5-0	Ma-102(C)	Diff. Equations & Ser.	5-0
Ma-201(C)	Graph & Mech.Comp.	0-2	Ph-610(B)	Atomic Physics	3-0
Ch-101(C)	Gen.Chemistry	3-2	Ch-111(A)	Fuel & Oil Chem.	2-2
Mc-101(C)	Static & Kinematics	3-0	Mc-102(C)	Plane Dynamics II	3-0
EE-171(C)	Elec.Circ. & Fields	3-4	EE-251(C)	A.C. Circuits	3-4
	Total	14-8		Total	16-6

Winter Term			Spring Term		
Ma-103(B)	Funct. of Sev. Var. & Vect. Anal.	5-0	Ma-104(A)	Part. Diff. Eq. & Rel. Topics	5-0
Ph-240(C)	Geom.H Phys.Optics	3-3	ME-712(A)	Dynam. of Mach.	3-2
ME-711(C)	Mech. of Mach.	3-2	ME-111(C)	Thermodynamics	4-2
Mc-201(A)	Methods of Dynamics	2-2	EE-451(C)	Transf. & Synchros	2-2
EE-351(C)	D.C. Machinery	2-2			
	Total	15-9		Total	14-6

Intersessional Field Trips

Second Year (NH2)

(1950-1953 Group)

Summer Term			Fall Term		
ME-112(B)	Thermodynamics	4-2	ME-211(C)	Mar. P.P. Equip.	3-2
Ch-561(A)	Physical Chem.	3-2	ME-411(C)	Hydrodynamics	3-2
ME-511(C)	Str. of Materials	5-0	ME-512(A)	Str. of Materials	5-0
EE-452(C)	Synch. Mach. & Induct. Motors	3-4	EE-751(C)	Electronics	3-4
			IE-101(C)	Ind. Org.	0-1
	Total	15-8		Total	14-9

Second Year (NH2) (Con't'd.)

(1950-1953 Group)

Winter Term			Spring Term		
ME-212(C)	Mar. P.P. Equip.	3-4	ME-217(C)	Int. Comb. Eng.	4-2
ME-412(A)	Hydrodynamics	4-2	Ae-431(A)	Turbines & Compr.	4-0
ME-611(C)	Mat. Testing Lab.	2-2	ME-513(A)	Theory of Elast.	3-0
Mt-201(C)	Phys. Met.	3-2	Mt-202(C)	Phys. Met.	3-2
IE-103(C)	Ind. Org.	0-1	IE-104(C)	Human Eng.	0-1
SL-101	New Weapons	0-1	SL-102	New Weapons	0-1
	Total	12-12		Total	14-6

Intersessional Field Trips

Third Year (NH3)

(1950-1953 Group)

Summer Term			Fall Term		
ME-215(B)	Mar. P.P. Anal.	2-4	ME-216(A)	Mar. P.P. Design	2-4
ME-310(B)	Heat Transfer	3-2	ME-811(C)	Mach. Design	3-2
ME-612(A)	Exp. Stress Anal.	3-2	EE-651(B)	Trans. & Servos	3-4
Mt-203(B)	Phys. Met.	2-2	Mt-301(A)	High Temp. Mat.	3-0
	Total	10-10		Total	11-10

Winter Term			Spring Term		
NE-101(C)	Nav.Eng.Main Prop.	3-0	NE-102(C)	Naval Eng. Aux.	3-0
ME-812(C)	Adv.Mach,Design	3-4	NE-103(C)	Eng. Dept. & Org.	1-0
	Thesis	2-10		Thesis	2-20
	Total	8-14		Total	6-20

NAVAL ENGINEERING

Gas Turbine Curriculum - NJ Groups

Objective

The objective of the curriculum is by means of practical and theoretical instruction to train a selected group of U. S. Navy officers to be capable of:

(a) Evaluating future trends in the field of Gas Turbine and Jet Propulsion and advising as to the limitaticns and capabilitiee of such means as applicable to propulsion requirements of naval vessels.

(b) Directing and supervising research and development in the field of Gas Turbine and Jet Propulsion as may be applicable to propulsion of naval vessels.

(c Acting in an advisory capacity with civilian establishments in the development and production of such naval machinery as may in the future be operated by the use of Gas Turbines and Jet Propulsion

First Year (NJ)

Summer Term

Ma-101(C)	Intro.to Eng. Math.	5-0
Ma-201(C)	Graph.& Mech. Comp.	0-2
Mc-101(C)	Statics & Kinematics	3-0
Ch-101(C)	Gen Chemistry	3-2
EE-171(C)	Elect.Cir & Fields	3-4
	Total	14-8

Fall Term

Ma-102(C)	Diff.Equation & Series	5-0
Mc-102(C)	Plane Dynamics	3-0
ME-141(C)	Eng'g Thermo.	4-2
Ae-100(C)	Basic Aerodynamics	3-4
	Total	15-6

Winter Term

Ch-111(A)	Fuel & Oil Chemistry	2-2
Ma-103(B)	Funct.of Sev. Var. & Vector Anal.	5-0
Ch-411(C)	Physical Chemistry	3-2
Mt-201(C)	Physical Metallurgy	3-2
ME-142(A)	Eng'g. Thermo	2-2
	Total	15-8

Spring Term

Ma-104(A)	Part.Diff.Eq.& Rel. Topics	5-0
Ch-412(C)	Physical Chemistry	2-2
Mt-202(C)	Physical Met. (Ferrous)	3-2
ME-143(A)	Eng'g. Thermo.	4-4
	Total	14-8

Intersessional Field Trips.

Second Year (NJ2)

Summer Term

Mt-301(A)	High Temp.Materials	3-0
Ma-105(A)	Fourier Series & Boundary Value Problems	4-0
ME-520(C)	Strength of Materials	5-0
ME-601(C)	Mat. Testing Lab.	0-2
Ae-501(A)	Theory of Aero.	4-0
	Total	16-2

Fall Term

Ma-106(A)	Complex Var. & Laplace Tr.	4-0
EE-251(C)	A.C. Circuits	3-4
Ch-701(C)	Chem.Eng.Calculations	3-2
IE-101(C)	Ind. Organization	0-1
Ae-502(A)	Theory of Aero.	4-0
	Total	14-7

NAVAL ENGINEERING--Gas Turbine Curriculum - NJ groups (Cont'd.)
Second Year (NJ2) (Cont'd.)

Winter Term			Spring Term		
Mt-203(B)	Physical Metallurgy	2-2	Ch-541(A)	Reaction Motors	2-2
EE-751(C)	Electronics	3-4	EE-452(C)	Sync. Mach. & Induc. Motors	3-4
EE-451(C)	Transf.&Synchros	2-2			
Ae-503(A)	Supersonic Aerodynamics	3-2	Ae-431(A)	Gas Turbines & Jets	3-2
Ae-451(C)	Gas Turbine Seminar	3-0	Ae-452(C)	Gas Turbine Seminar	3-0
*IE-103(C)	Ind. Engineering	0-1	*IE-104	Ind. Engineering	0-1
*SL-101	New Weapons	0-1	*SL-102	New Weappns	0-1
	Total	13-12		Total	11-10

*Lecture Course

Intersessional Field Trip

Third Year (NJ3)

At Massuchetts Institute of Technology

Term I - Summer 1950		Term II - Fall 1950	
M351	Adv. Calc. for Engineers	2.491	Flow of Compress. Fluids
M352	Adv. Calc. for Engineers	2.213	Gas Turbines
2.40	Heat Engineering	10.70	Combustion, Prin. of
		- -	Thesis

Term III - Spring 1951

2.28 Fluid Machinery
2.214 Gas Turbines
- - Thesis

NAVAL ENGINEERING

Electrical Curriculum - NL Groups

Objective

The objective of this curriculum is to develop officers competent to direct the inspection, installation, and maintenance of naval machinery and equipment (excepting radio and underwater sound equipment) over which the Bureau of Ships has cognizance or for which the engineer officer afloat is held responsible by the U. S. Navy Regulations.

Specifically, the objective is to provide officers, subject to having attained suitable rank and experience, competent to perform the following duties:

(a) Engineer officers of all types of naval vessels, and staff engineers afloat.

(b) Assignment to the operation and maintenance divisions of the Bureau of Ships.

(c) Assignment to navy yards, repair ships, and repair bases in connection with production, or maintenance and repair.

(d) Assignment to test and research activities such as the Naval Boiler Laboratory, Engineering Experiment Station, Naval Research Laboratory, and Material Test Laboratory.

(E) Inspectors of Naval machinery and Material.

First Year (NL)

Summer Term

Ma-101(C)	Intro. to Eng. Math.	5-0
Ma-201(C)	Graph.& Mech. Comp.	0-2
EE-171(C)	Elect. Cir.& Fields	3-4
Ch-101(C)	General Chemistry	3-2
Mc-101(C)	Statics & Kinematics	3-0
	Total	14-8

Fall Term

Ma-102(C)	Diff.Equations & Series	5-0
EE-271(C)	A.C. Circuits	3-2
Ch-111(A)	Fuel & Oil Chem.	2-2
Mc-102(C)	Plane Dynamics	3-0
Ph-610(B)	Atomic Physics	3-0
	Total	16-4

Winter Term

Ma-103(B)	Funct of Sev Var & Vector Anal	5-0
EE-272(C)	A C.Circuits	2-2
Mc-201(A)	Methods of Dynamics	2-2
ME-500(C)	Str. of Materials	3-0
ME-601(C)	Mat. Testing Lab.	0-2
Mt-201(C)	Physical Met.	3-2
	Total	15-8

Spring Term

Ma-104(A)	Part. Diff. Eq. & Rel. Topics	5-0
EE-371(C)	D.C. Machinery	3-2
ME-111(C)	Thermodynamics	4-2
Mt-202(C)	Physical Met. (Ferrous)	3-2
	Total	15-6

Intersessional Field Trip.

Second Year (NL2)

Summer Term

Ma-105(A)	Fourier Ser.& Boundary Value Probs	4-0
EE-471(C)	Trans. Async. Mach. & Synchros.	3-4
ME-112(B)	Thermodynamics	4-2
Mt-203(B)	Phy. Metallurgy	2-2
	Total	13-8

Fall Term

Ma-106(A)	Complex Var.& Laplace	4-0
EE-472(C)	Synchronous Mach.	3-4
EE-971(A)	Seminar	1-0
ME-411(C)	Hydromechanics	3-2
ME-211(C)	Mar. P.P. Equipment	3-2
*IE-101(C)	Ind. Org.	0-1
	Total	14-9

*Substitute Mt-203 (C) for 1948-51 group.

Winter Term

Ph-361(A)	Electromagnetism	3-0
EE-571(B)	Trans.Lines & Filters	3-4
EE-971(A)	Seminar	1-0
ME-212(C)	Mar. P.P. Equip.	3-2
EE-771(B)	Electronics	3-2
*IE-103	Ind. Org.	0-1
*SL-101	New Weapons	0-1
	Total	13-10

Spring Term

ME-217(C)	Int. Comb. Eng.	4-4
Ph-362(A)	Electromagnetic Waves	3-0
EE-772(B)	Electronics	3-2
EE-971(A)	Seminar	1-0
Ma-301(B)	Statistics	3-2
*IE-104	Human Eng.	0-1
*SL-102	New Weapons	0-1
	Total	14-8

*Lecture Course.

Intersessional Field Trip

Third Year (NL3)

Summer Term			Fall Term		
#ME-310(B)	Heat Transfer	3-2	*Mt-301(A)	High Temp. Met.	3-0
EE-871(A)	Elect. Mach. Design	4-0	EE-872(A)	Elect.Mach. Design	4-0
EE-671(A)	Transients	3-4	EE-971(A)	Seminar	1-0
ME-215(B)	Mar. P.P. Analysis	2-4	EE-672(A)	Servo Mechanisms	3-4
				Thesis	3-0
	Total	12-10			
				Total	14-4

*Substitute Mt-301(A) for 1948-1951 Group.
#Substitute ME-215(B) for 1948-1951 Group.

Winter Term			Spring Term		
EE-873(A)	Elect. Mach. Design	4-0	EE-971(A)	Seminar	1-0
EE-971(A)	Seminar	1-0	NE-102(C)	Mar.Eng.(Aux.Mach)	3-0
NE-101(C)	Mar.Eng.(Main Prop.)	3-0	NE-103(C)	Mar. Eng. Org	1-0
	Thesis	9-0		Thesis	12-0
	Total	17-0		Total	17-0

NAVAL ENGINEERING

Metallurgy Curriculum - NM Groups

Objective

The objective of this curriculum is to provide the training necessary for a selected group of officers to be:

(a) Capable of supervising and directing activities at the Standards Branch Bureau of Ships relating to metals and alloys.

(b) To advise the Bureau of Ships of developments in metallurgy that may be of value in ship design, maintenance, and operation.

(c) To be capable of directing and supervising research activities involving metals and alloys, and direct activities in Naval Establishments concerned with production, maintenance, and repair.

First Year (NM)

Next group begins in 1951. Then alternate years

Summer Term			Fall Term		
Ma-171(C)	Special Topics in Calc.	3-0	Ch-521(A)	Plastics(Eng.Materials)	3-2
Ma-201(C)	Graph.& Mech. Comp.	0-2	Ma-172(C)	Fourier Series & Rel. Topics	3-0
Mc-101(C)	Statics & Kinematics	3-0			
Ch-101(C)	General Chemistry	3-2	Ch-221(C)	Qualitative Analysis	3-2
†EE-	Elect. Eng.	3-4	Mt-101(C)	Production Metallurgy	2-0
			Mt-201(C)	Physical Metallurgy	3-2
	Total	12-8			
				Total	14-6

† Under revision.

First Year (NM) - (Cont'd.)

Winter Term			Spring Term		
Ma-173(B)	Funct. of Sev. Var. & Intro. Vect.	3-0	Mt-203(B)	Phys. Metallurgy (Spec Topics)	2-2
ME- 500(C)	Str. of Materials	3-0	Ch-531(A)	Phys. Chem.of Metal.	2-0
ME-601(C)	Mat. Test. Lab.	0-2	Ch-412(C)	Physical Chem.	2-2
Ch-411(C)	Physical Chemistry	3-2	Mt-204(A)	Physical Metal.	3-4
Mt-202(C)	Physical Metallurgy (Ferrous)	3-2	Cr-271(B)	Cry. & X-Ray	3-2
*SL-101	New Weapons	0-1	*SL-102	New Weapons	0-1
Ch-231(C)	Quan. Anal.	2-4		Total	12-11
	Total	14-11			

*Lecture Course.

Intersessional Field Trip.

Second Year (NM2)

at Carnegie Institute of Technology

First Term		Second Term	
GE-657a	Alloy Steels	GE-657a	Alloy Steels
E-631	Fer. Met.	GE-664b	Adv. Phys Met.
GE-664a	Av. Phys. Met.	E-652	Mech Met
GE-697	Ord. Met.	GE-655b	Met. Problems
E-661	Mod. Met. Proc.	E-662	Mod. Met Practice
GE-633c	Radiography	S-292	Stat. Qual. Cont.
S-291	Stat. Qual. Cont.	E-666	Seminar
E-655	Seminar		

Intersessional Field Trip

Third Year (NM3)

at Carnegie Institute of Technology

First Term		Second Term	
GE-667a	Adv. Mech. Met.	GE-667b	Adv. Mech. Met.
GE-697	Ord. Met.	E-660	Met. Engrg
E-661	Mod. Met. Prac.	E-662	Mod. Met. Practice
GE-676a	Theory of metals	GE-676b	Theory of metals
GE-674a	Grad. Seminar	GE-674b	Grad. Seminar
E-647	Non-Fer. Metal	GE-633c	Crystallography
E-697	Welding Met.	GE-644d	Adv. Phys. Met.

NAVAL ENGINEERING

Petroleum Curriculum - NP Groups

Objective

The objective of this curriculum is, by means of practical and theoretical instruction, to train certain officers of the U. S. Navy in the technology of petroleum production, refineing, and utilization of by-products therefrom, in preparation for future duties involving the development, properties, uses and application of fuels and lubricants in the Naval Establishment.

First Year (NP)

Next group begins in 1951. Then alternate years.

Summer Term			Fall Term		
Ma-171(C)	Special Topics in Calc.	3-0	Ma-172(C)	Fourier Series & Rel. topics	3-0
Ma-201(C)	Graph. & Mech. Comp.	0-2			
Mc-101(C)	Statics & Kinematics	3/0	Ge-101(C)	Phys. Geology	3-0
Ch-101(C)	General Chemistry	3-2	Ch-221(C)	Qualitative Analysis	3-2
†EE-	Elect. Eng.	3-4	Cr-301(B)	Cry & Mineralogy	3-4
			Mt-201(C)	Physical Metallurgy	3-2
	Total	12-8		Total	15-8

Winter Term			Spring Term		
Ch-411(C)	Physical Chem.	3-2	Ch-301(C)	Org. Chemistry	3-2
Ch-111(A)	Fuel & Oil Chem.	2-2	Ch-412(C)	Physical Chemistry	2-2
Ch-231(C)	Quantitative Analysis	2-4	Mt-202(C)	Phy. Meta.(Ferrous)	3-2
GE-302(C)	Determin.Mineralogy	1-4	Ge-241(C)	Petroleum Geology	2-2
ME-500(C)	Str. of Materials	3-0	Ge-401(C)	Petrology & Petrography	2-3
ME-601(C)	Mat. Test. Lab.	0-2			
*SL-101	New Weapons	0-1	*SL-102	New Weapons	0-1
	Total	11-15		Total	12-12

†Under revision.

*Lecture Course.

Intersessional Field Trip.

Second Year (NP2)

at University of California at Berkeley

(Academic year includes two terms)

First Term	Second Term
Chem. 8 Org. Chemistry	PE 121B Pet. Prod. Meth.
Chem. 9 Org. Chem. Lab.	PE 125 Pet. Prod. Econ.
ME 103 Fluid Mech.	PE 299 Thesis Research
PE 121A Oil Field Dev.	Phy121 Intro. to Atom. Struc.
PE 129 Prod. & Util. Nat. Gas	Math264 Quality Control

Intersessional Field Trip.

Third Year (NP3)

at University of California at Berkeley

First Term			Second Term		
Chem.	109	Phys. Chem.	PE	209B	Seminar Pet. Refin
Chem.	143	Intro. to Chem. Eng	ME	118	Indust. Pow Plant Des
PE	209A	Seminar Pet. Refin	PE	299	Thesis Research
PE	299	Thesis Research	PE	213	Val. Oil & Gas Prod Prop.
E	120	Eng. Invest. & Econ.			

ORDNANCE ENGINEERING CURRICULA

The objective of all Ordnance Engineering Curricula is to prepare officers for shore duty assignments under the cognizance of the Bureau of Ordnance. This duty includes technical and technical administrative billets within the Bureau of Ordnance and in its field activities, which include the Naval Ordnance Test Stations, the Naval Proving Ground, the Naval Ordnance Laboratory, the Naval Ammunition Depots and Magazines, the Naval Gun Factory, the Naval Ordnance Plants and the Naval Powder Factory. While the curricula are definitely pointed toward shore duty assignments in Ordnance Activities, the knowledge acquired will be of exceedingly great value in gunnery billets afloat.

ORDNANCE ENGINEERING

General Ordnance Curriculum - O Groups

Objective

The objective of the Ordnance Engineering (General) curriculum is to prepare officers for future duties as inspectors of ordnance material, to equip them to deal with problems of development and production in Bureau of Ordnance establishments, and to give them the basic technical education to become expert operators of ordnance equipment afloat

First Year (O)

Summer Term			Fall Term		
Ma-101(C)	Intro. to Eng. Math.	5-0	Ma-102(C)	Diff. Eq. and Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	EE-251(C)	A.C. Circuits	3-4
EE-151(C)	DC Cir. & Fields	3-4	Mc-102(C)	Plane Dynamics	3-0
Ch-101(C)	Gen. Inorganic Chem.	3-2	Ch-521(A)	Plastics	3-2
Or-120(C)	Surface Fire Control	2-0	Or-131(C)	A.A. Fire Control	1-2
	Total	16-6		Total	15-8

Winter Term			Spring Term		
Ma-103(G)	Func. of Several Var & Vector Analysis	5-0	Ma-104(A)	Partial Diff. Eq. & Related Topics	5-0
Ma-251(C)	Grph. & Mech. Comp.	0-4	ME-700(C)	Kinematics of Mach	3-2
Mc-103(C)	Space Dynamics	2-0	EE-452(C)	Syn. Mach. & Ind. Mtrs.	3-4
EE-451(C)	Transf. & Synchros	2-2	Or-151(C)	Underwater Ordnance	2-0
ME-540(C)	Strength of Materials	5-0	Or-110(C)	Ord. Admin.	2-0
Or-132(C)	A.A. Fire Control	2-0	SL-102	New Wep. Dev. Lect.	---
SL-101	New Weapon Dev. Lect.	---			
	Total	16-6		Total	15-6

Intersessional Field Trip.

SECOND YEAR (02)

Summer Term

Ma-155(A)	Matrices & Calculus of Variations	3-0
EE-551(B)	Trans Lines & Filters	3-2
Ph-250(C)	Optics, Geom. & Phys.	3-2
EE-751(C)	Electronics	3-4
Or-141(C)	Guided Missiles	2-0
Or-152(C)	Underwater Ord.	2-0
	Total	16-8

Fall Term

Mc-421(A)	Interior Ballistics	2-0
Ma-106(A)	Complex Var. & LaPlace Trans.	4-0
Es-446(C)	Intro. To Radar	2-2
Ma-351(B)	Statistics I	2-2
Mc-401(A)	Exterior Ballistics	3-0
Ph-450(B)	Acoustics(Underwater)	3-2
Or-142(C)	Guided Missile Guidance	1-0
IE-101	Indus. Management Lect	---
	Total	17-6

Winter Term

Ma-352(A)	Statistics II	1-2
Mc-402(A)	Dyn. of Missiles & Gyros	3-0
EE-671(A)	Transients	3-4
Ch-631(A)	Thermodynamics	3-2
Mt-201(C)	Intro Physical Metal	3-2
IE-103	Indus Management Lect	---
SL-101	New Weapon Dev. Lect	---
	Total	13-10

Spring Term

Mc-431(A)	Strength of Guns	3-0
EE-672(A)	Servo-Mechanisms	3-4
Mt-202(C)	Ferrous Phys. Metallurgy	3-2
Ch-541(A)	Reaction Motors	2-2
ME-840(C)	Manufacturing Eng.	3-2
IE-104	Indus Management Lect.	---
SL-102	New Weapon Dev. Lect.	---
	Total	14-10

Intersessional Field Trip

THIRD YEAR (03)

At Purdue University

Fall Term

GE-128 Motion & Time Study
GE-183 Production Planning
GE-184 Tool Design
GE-117 Industrial Personnel Relations
GE-91 Elementary Accounting
Psych-173 Personnel Psychology

Spring Term

GE-185 Production Control
GE-186 Plant Layout
GE-299 Thesis
Psych-175 Psychology of Industrial Training

ORDNANCE ENGINEERING

Fire Control Ordnance Curriculum - OC Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OC)

Summer Term			Fall Term		
Ma-101(C)	Intro. to Eng. Math.	5-0	Ma-102(C)	Diff Eq and Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	Mc-102(C)	Plane Dynamics	3-0
EE-151(C)	DC Cir & Fields	3-4	EE-251(C)	A C. Circuits	3-4
Ch-101(C)	Gen. Inorganic Chem	3-2	Ma-106(A)	Complex Var.& Laplace Transform	4-0
Or-120(C)	Surface Fire Control	2-0	Or-131(C)	A.A. Fire Control	1-2
	Total	16-6		Total	16-6

Winter Term			Spring Term		
Ma-103(B)	Func. of Several Var & Vector Anal.	5-0	Ma-104(A)	Partial Diff Eq. & Related Topics	5-0
Mc-103(C)	Space Dynamics	2-0	EE-455(C)	Async. Motors	2-2
EE-451(C)	Transformers & Synchros	2-2	Es-262(C)	Electron Tubes & Cir.	3-2
Es-261(C)	Electron Tubes & Cir	3-2	Ma-451(A)	Math. Comp. by Mech. Means	3-2
Or-132(C)	A.A Fire Control	2-0	Mc-201(A)	Methods in Dynamics	2-2
EE-551(B)	Trans. Lines & Filters	3-2	SL-102	New Weapon Dev.Lect.	---
SL-101	New Weapons Dev.Lect.	---			
	Total	17-6		Total	15-8

INTERSESSIONAL FIELD TRIP

Second Year (OC2)

At M.I.T.

Fall Term		Spring Term	
6.20	Elect. Cont. & Meas.	6.536	Machine Computation
6.581	Trans. in Linear Sys.	6.605	Servomechanisms
6.756	Elec. Meas. Lab.	6.623	Pulse Circuits, Prin.
16.41	Intr to F.C. Instr.	16.42	F.C Inst. Adv.
16.43	F.C. Inst. Lab.	16.46	F.C. Inst. Lab., Adv.

Intersessional Field Trip

Third Year (OC3)

At

M.I.T.

Fall Term		Spring Term	
6.607	Servomechanisms Lab.	16.422	Spec. Prob. in F.C.
6.608	Servomechanisms		Thesis
16.45	E.C. Inst., Adv.		
6291	Principals of Radar		
	Thesis		

ORDNANCE ENGINEERING

Guided Missile Control Ordnance Curriculum - OG Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OG)

Summer Term			Fall Term		
Ma-101(C)	Intro.to Eng. Math.	5-0	Ma-102(C)	Diff. Eq. and Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	Mc102(C)	Plane Dynamics	3-0
EE-151(C)	DC Cir. & Fields	3-4	EE-251(C)	A.C! Circuits	3-4
Ch-101(C)	Gen.Inorganic Chem.	3-2	Ae-100(C)	Basic Aerodynamics	3-4
Or-120(C)	Surface Fire Control	2-0	Or-131(C)	A.A. Fire Control	1-2
	Total	16-6		Total	15-10

Winter Term			Spring Term		
Ma-103(B)	Func. of Several Var. & Vector Anal.	5-0	Ma-104(A)	Partial Diff. Eq. & Related Topics	5-0
Mc-103(C)	Space Dynamics	2-0	Ma-451(A)	Math. Comp. by Mech. Means	3-2
EE-451(C)	Transformers & Synchros	2-2	EE-455(C)	Async. Motors	2-2
Or-132(C)	A.A. Fire Control	2-0	Or-110(C)	Ord. Admin.	2-0
SL-101	New Weapons Dev.Lect.	---	SL-102	New Weapons Dev.Lect.	---
Or-141(C)	Guided Missiles	2-0	Or-142(C)	Guided Missile Guid.	1-0
Ae-121(C)	Tech. Aerodynamics	3-2	Ae-136(B)	Aircraft Perf.-Flight Analysis	3-2
	Total	16-4		Total	16-6

Intersessional Field Trip.

Second Year (OG 2)

Summer Term			Fall Term		
Ma-155(A)	Matrices & Calc. of Variations	3-0	Mc-401(A)	Exterior Ballistics	3-0
EE-551(B)	Trans.Lines & Filters	3-2	Ma-106(A)	Compl.Va.& LaPlace Tr.	4-0
EE-751(C)	Electronics	3-4	ME-132(C)	Eng. Thermodynamics	3-2
ME-131(C)	Engrg-Thermodynamics	4-2	EE-755(A)	Electronic Cont.& Meas.	3-4
Ae-501(A)	Hydro-aero-mechanics	4-0	Ae-502(A)	Hydro-aero-mechanics	4-0
			IE-101	Prins.of Indus. Org.	---
	Total	17-8		Total	17-6

Second Year (OG2)

Winter Term			Spring Term		
Mc-402(A)	Dyn. of Missiles & Gyros	3-0	EE-753(C)	Electronics	1-2
EE-671(A)	Transients	3-4	EE-672(A)	Servomechanisms	3-4
Ae-503(A)	Compressibility	4-0	Mc-201(A)	Methods in Dynamics	2-2
Ch-631(A)	Thermodynamics	3-2	Es-456(C)	Intro. to Radar	2-2
SL-101	New Weapons Dev. Lect.	---	Ch-541(A)	Reaction Motors	2-2
IE-103	Applied Indus. Org.	---	SL-102	New Weapons Dev. Lab.	---
			IE-104	Psychophysical Sys. Res.	---
	Total	13-6			
				Total	10-12

Intersessional Field Trip.

Third Year (OG3)

At Johns Hopkins University

Fall Term		Spring Term	
			U.H.F. Theory
601	Seminar	604	Journal
603	Journal	602	Seminar
	Advanced Servomechanisms		Advanced Servomechanisms
609	Elements of Admin.	602	Factory Org. & Management
	Thesis		Thesis
	U.H.F. Theory		

ORDNANCE ENGINEERING

Jet Propulsion Ordnance Curriculum - OJ Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OJ)

Summer Term			Fall Term		
Ma-101(C)	Intro. to Eng. Math.	5-0	Ma-102(C)	Diff. Eq. and Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	Ae-100(C)	Basic Aerodynamics	3-4
EE-151(C)	DC Cir. & Fields	3-4	Or-131(C)	A.A. Fire Control	1-2
Ch-101(C)	Gen. Inorganic Chem.	3-2	EE-251(C)	A.C. Circuits	3-4
Or-120(C)	Surface Fire Control	2-0			
	Total	16-6		Total	12-10

First Year (OJ) (Cont'd)

Winter Term

Ma-103(B)	Func. of Several Var & Vector Anal.	5-0
EE-451(C)	Transformers & Synchros	2-2
Mt-201(C)	Intro Physical Metallurgy	3-2
Ch-411(C)	Physical Chemistry	3-2
Or-132	A.A. Fire Control	2-0
SL-101	New Weapons Dev. Lect	---
Or-141(C)	Guided Missiles	2-0
	Total	17-6

Spring Term

Ma-104(A)	Partial Diff Eq & Related Topics	5-0
EE-455(C)	Async Motors	2-2
Ph-540(B)	Kinematic Theory & Stat Mech	3-0
Mt-202(C)	Ferrous Phys. Metal	3-2
Ch-412(C)	Physical Chemistry	2-2
Or-110(C)	Ord. Admin	2-0
SL-102	New Weapons Dev. Lect.	---
	Total	17-6

Intersessional Field Trip.

Second Year (OJ2)

Summer Term

EE-751(C)	Electronics	3-4
Mt-301(A)	High Temp Materials	3-0
Ph-250(C)	Optics, Geom. & Phys	3-2
Ae-501(A)	Hydro-aero-mechanics	4-0
	Total	13-6

Fall Term

Ma-106(A)	Compl Var & LaPlace Tr	4-0
Me-141(C)	Eng Thermo	4-2
EE-755(A)	Electronic Control & Meas	3-4
Ae-502(A)	Hydro-aero-mechanics II	4-0
Or-142(C)	Guided Missile Guid	1-0
IE-101	Prins of Indus. Org.	---
	Total	16-6

Winter Term

Ae-503(A)	Compressibility	4-0
ME-142(A)	Eng. Thermo.	2-2
ME-540(C)	Strength of Materials	5-0
EE-671(A)	Transients	3-4
IE-103	Applied Indus. Org.	---
SL-101	New Weapons Dev. Lect	---
	Total	14-6

Spring Term

Ae-431(A)	Internal Flow in Aircraft Engines	4-0
Ch-541(A)	Reaction Motors	2-2
EE-672(A)	Servomechanisms	3-4
ME-143(A)	Eng Thermo	4-4
IE-104	Psychophysical Sys. Res	---
SL-102	New Weapons Dev. Lect.	---
	Total	13-10

Intersessional Field Trip

Third Year (OJ3)

At Cal. Inst. of Technology

First Term		Second Term	Third Term
AE 261	Hydrodynamics	Same as	Same as
AE 272	Precision Meas		
AE 290	Aeronautics Seminar	First	First
JP 121	Rockets		
JP 130	Thermal jets	Term	Term
JP 170	Jet Prop Lab		
JP 200	Chem. Probs in jet prop		
JP 210	High Temp Design Probs.		
JP 280	Research Jet Probs.		

ORDNANCE ENGINEERING

Metallurgical Ordnance Curriculum - OM Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OM)

Summer Term			Fall Term		
Ma-101(C)	Intro. to Eng. Math.	5-0	Ma-102(C)	Diff. Eq. and Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	Ch-221(C)	Qualitative Analysis	3-2
EE-151(C)	DC Cir. & Fields	3-4	EE-251(C)	A.C Circuits	3-4
Ch-101(C)	Gen. Inorganic Chem.	3-2	Mt-101(C)	Production Metallurgy	2-0
Or-120(C)	Surface Fire Control	2-0	Mt-201(C)	Intro Phys. Metal.	3-2
	Total	16-6		Total	16-8

Winter Term			Spring Term		
Ma-103(B)	Func. of Several Var. & Vector Anal.	5-0	Ma-104(A)	Par. Diff. Eq & Related Topics	5-0
Ch-231(C)	Quantitative Analysis	2-4	Ch-412(C)	Physical Chemistry	2-2
Ch-411(C)	Physical Chemistry	3-2	Ch-531(A)	Physical Chem. of Metal.	2-0
EE-451(C)	Transformers & Synchros	2-2	Cr-271(B)	Crystal & X-Ray Tech.	3-2
Mt-202(C)	Ferrous Phys. Metal.	3-2	Mt-204(A)	Physical Metallurgy	3-4
SL-101	New Weapons Dev. Lect	---	SL-102	New Weapons Dev. Lect.	---
	Total	15-10		Total	15-8

Intersessional Field Trip.

Second Year (OM2)

Summer Term			Fall Term		
EE-751(C)	Electronics	3-4	ME-511(C)	Strength of Materials	5-0
Mt-206(A)	Physics of Metals	3-2	EE-755(A)	Electronic Con. & Meas.	3-4
Or-152(C)	Underwater Ordnance	2-0	Mc-421(A)	Interior Ballistics	2-0
Ph-250(C)	Optics, Geom. & Phys.	3-2	Mt-103(C)	Prod. of Non-Ferrous Met.	3-0
Mt-301(A)	High Tem. Materials	3-0	Or-131(C)	A.A. Fire Control	1-2
	Total	14-8	IE-101	Prins. of Indus. Org.	---
			Mt-102(C)	Prod. of Steel	3-0
				Total	17-6

Second Year (OM2) (Cont'd)

Winter Term			Spring Term		
ME-512(A)	Strength of Materials Adv.	5-0	Ma-301(B)	Statistics	3-2
Mt-205(A)	Adv. Phys. Metallurgy	3-4	Mc-431(A)	Strength of Guns	3-0
Mt-302(A)	Alloy Steels	4-2	ME-632(B)	Exptl. Stress. Anal.	2-2
Or-132(C)	A.A. Fire Control	2-0	Mt-203(B)	Physical Metallurg. (Sp. Topics)	2-2
Ph-610(B)	Atomic Physics	3-0	Mt-303(A)	Metals Seminar	1-0
IE-103	Applied Indus. Org.	---	Or-110(C)	Ord. Admin.	2-0
SL-101	New Weapons Dev.Lect.	---	Or-151(C)	Underwater Ordnance	2-0
			IE-104	Psychophysical Sys.Res.	---
	Total	17-6	SL-102	New Weapons Dev.Lect.	---
				Total	15-6

Intersessional Field Trip.

Third Year (OM3)

At Carnegie Inst. of Technology

(Tentative)

Fall Term		Spring Term	
GE	Corrosion	GE	Corrosion
GE 676a	Theory of Metals	GE 676b	Theory of Metals
GE 667a	Adv. Mech. Metallurgy	GE 667b	Adv. Mech. Met
GE 655a	Met. Probs.	GE 655b	Met. Probs.
GE 674a	Grad. Seminar	GE 674b	Grad. Seminar
GE 696	Welding Met.	GE 670	Light Alloys
E 647	Non-Ferr. Metallog.	E 652	Mech. Met.
E 641	Ferr. Metallog.	E 660	Met. Eng. (audit)
E 630	Ferr. Metallurgy		

ORDNANCE ENGINEERING

Chemical Ordnance Curriculum - OP Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OP)

Summer Term			Fall Term		
Ma-101(C)	Intro to Eng Math.	5-0	Ma-102(C)	Diff Eq & Series	5-0
Mc-101(C)	Statics & Kinematics	3 0	EE-251(C)	A C. Circuits	3-4
EE-151(C)	DC Cir. & Fields	3-4	Ch-221(C)	Qualitative Analysis	3-2
Ch-101(C)	Gen Inorganic Chem.	3-2	Ch-311(C)	Organic Chemistry	3-2
Or-120(C)	Surface Fire Control	2-0			
	Total	16-6		Total	14-8

Winter Term			Spring Term		
Ma-103(B)	Func. of Seveeal Var & Vector Anal	5-0	Ma-104(A)	Part Diff Eq & Related Topics	5-0
EE-451(C)	Transformers & Synchros	2-2	Ph-540(B)	Kinetic Theory & Stat Mech.	3-0
Ch-231(C)	Quantitative Analysis	2-4	Ch-412(C)	Physical Chemistry	2-2
Ch-312(C)	Organic Chemistry	3-2	Ch-701(C)	Chem Eng. Calc.	3-2
Ch-411(C)	Physical Chemistry	3-2	Cr-271(B)	Crystal & X-Ray Tech.	3-2
SL-101	New Weapons Dev Lect.	---	Or-151(C)	Underwater Ordnance	2-0
	Total	15-10	SL-102	New Weapons Dev. Lect.	---
				Total	18-6

Intersessional Field Trip

Second Year (OP2)

At Naval Postgraduate School

Summer Term			Fall Term		
Ch-321(A)	Organic Qualitative Analysis	2-2	Ch-322(A)	Adv Organic Chem.	3-2
Ch-413(A)	Physical Chemistry Adv	2-2	EE-755(A)	Electronic Con & Meas.	3-4
EE-751(C)	Electronics	3-4	ME-141(C)	Eng Thermo.	4-2
Or-141(C)	Guided Missiles	2-0	Mc-421(A)	Interior Ballistics	2-0
Or-152(C)	Underwater Ord	2-0	Or-131(C)	A A Fire Control	1-2
Ph-250(C)	Optics, Geom & Phys	3-2	Or-142(C)	Guided Missile Guidance	1-0
			IE-101	Prins of Indus. Org	---
	Total	14-10		Total	14-10

Second Year (OP2) (Cont'd.)

Winter Term			Spring Term		
Ch-521(A)	Plastics	3-2	Ch-541(A)	Reaction Motors	2-2
Ch-323(A)	Chem. High Polymers	3-0	Ch-800(A)	Chemistry Seminar	2-0
ME-142(A)	Eng. Thermo.	2-2	ME-143(A)	Eng. Thermo.	4-4
Mt-201(C)	Intro Phys.Metallurgy	3-2	Mt-202(C)	Ferrous Phys. Metal.	3-2
Or-132(C)	A.A.Fire Control	2-0	Or-110(C)	Ord. Admin.	2-0
Ph-610(B)	Atomic Physics	3-0	Mc-431(A)	Strength of Guns	3-0
IE-103	Applied Indus. Org.	---	IE-104	Psychophysical Sys.Res.	---
SL-101	New Weapons Dev.Lect.	---	SL-102	New Weapons Dev.Lect.	---
	Total	16-6		Total	16-8

Intersessional Field Trip.

Third Year (OP3)

At Lehigh University.

First Semester		Second Semester	
Chem. 220	Adv. Phys. Chem.	Chem. 221	Adv. Phys. Chem.
Chem. 157	Qual. Organic Anal.	Chem. 158	Adv. Organic Chem.
Chem. 202	Adv. Inorganic Chem.	Chem. 232	Adv. Analytical Chem.
Chem. 2--	--- Chem. Research	Chem. 2--	--- Chem. Research
Ph 160	Intro. to modern Phys. Theories	Ph. 161	Intro. to modern Phys. Theories

ORDNANCE ENGINEERING

Electronics Ordnance Curriculum - OR Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above

First Year (OR)

Summer Term			Fall Term		
Ma-101(C)	Intro.to Eng. Math.	5-0	Ma-102(C)	Diff. Eq. and Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	Mc-102(C)	Plane Dynamics	3-0
EE-151(C)	DC Cir. & Fields	3-4	Es-112(C)	Electricity	4-3
Ch-101(C)	Gen.Inorganic Chem.	3-2	Ae-100(C)	Basic Aerodynamics	3-4
Or-120(C)	Surface Fire Control	2-0			
	Total	16-6		Total	15-7

Electronics Ordnance Curriculum - First Year (OR) - (Cont'd.)

Winter Term			Spring Term		
Ma-103(B)	Func. of Several Var. & Vector Anal.	5-0	Ma-104(A)	Partial Diff. Eq. & Related Topics	5-0
EE-451(C)	Transformers & Synchros	2-2	Es-226a(A)	Pulse Circuits	2-1
Es-113(C)	Circuit Anal. & Meas.	3-3	Es-114(C)	Circuit Anal. & Meas.	3-3
Es-261(C)	Electron Tubes & Cir.	3-2	Es-262(C)	Electron Tubes & Cir.	3-2
Mc-103(C)	Space Dynamics I	2-0	EE-455(C)	Asynchronous Mach.	2-2
SL-101	New Weapons Dev. Lect.	---	SL-102	New Weapons Dev. Lect.	---
	Total	15-7		Total	15-8

Intersessional Field Trip.

Second Year (OR2)

Summer Term			Fall Term		
Ae-501(A)	Hydro-aero-mechanics	4-0	Ae-502(A)	Hydro-aero-mechanics	4-0
Es-621(A)	Electromagnetics	3-0	EE-755(A)	Electronic Con. & Meas.	3-4
Es-431(B)	Radar	3-3	Es-622(A)	Electromagnetics	4-0
Or-152(C)	Underwater Ord.	2-0	Or-131(C)	A.A. Fire Control	1-2
Ph-250(C)	Geom. & Physical Optics	3-2	Ph-450(B)	Acoustics (Underwater)	3-2
			IE-101	Prins. of Indus. Org.	---
	Total	15-5		Total	15-8

Winter Term			Spring Term		
Ae-503(A)	Compressibility	4-0	Ch-541(A)	Reaction Motors	2-2
Ch-631(A)	Thermodynamics	3-2	EE-672(A)	Servomechanisms	3-4
Es-121(A)	Adv. Circuit Theory	3-2	Es-122(A)	Adv. Circuit Theory	3-2
Es-623(A)	Electromagnetics	4-0	Es-624(A)	Electromagnetics	3-0
Or-132(C)	A.A. Fire Control	2-0	Or-110(C)	Or. Admin.	2-0
Or-141(C)	Guided Missiles	2-0	Or-142(C)	Guided Missile Guid.	1-0
IE-103	Applied Indus. Org.	---	IE-104	Psychophysical Sys. Res	---
SL-101	New Weapons Dev. Lect.	---	SL-102	New Weapons Dev. Lect.	---
	Total	18-4		Total	14-8

Intersessional Field Trip.

Third Year (OR3)

At M.I.T.

Fall Term		Spring Term	
6.621	Microwave Circuits	6.502	Electrical Eng. Seminar
6.633	Electronic-Circ. Theory	6.562	Network Theory. Adv.
6.501	Electrical Eng. Seminar	6.622	Antennas
6.561	Nerwork Theory, Adv.		Thesis
L17	Scientific German		
6.623	Pulse Cir. Prin.		
	Thesis		

ORDNANCE ENGINEERING

Mechanical Electrical Propulsion Ordnance Curriculum - OT Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OT)

Summer Term			Fall Term		
Ma-101(C)	Intro.to Eng. Math.	5-0	Ma-102(C)	Diff., Eq. & Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	Mc-102(C)	Plane Dynamics	3-0
EE-151(C)	DC Cir., & Fields	3-4	EE-251(C)	A.C. Circuits	3-4
Ch-101(C)	Gen.Inorganic Chem.	3-2	Ae-100(C)	Basic Aerodynamics	3-4
Or-120(C)	Surface Fire Control	2-0			
	Total	16-6		Total	14-8

Winter Term			Spring Term		
EE-451(C)	Transformers & Synchros	2-2	EE-455(C)	Sync. Motors	2-2
Ma-103(B)	Func of Sereral Var. & Vector Anal.	5-0	Ma-104(A)	Partial Diff Eq. & Related Topics	5-0
Mc-103(C)	Space Dynamics	2-0	Mc-201(A)	Methods in Dynamics	2-2
Mt-201(C)	Intro., Physical Metal.	3-2	Mt-202(C)	Ferrous Phys. Metal.	3-2
ME-540(C)	Strength of Materials	5-0	Or-151(C)	Underwater Ordnance	2-0
SL-101	New Weapons Dev. Lect.	---	Or-110(C)	Ord. Admin.	2-0
			SL-102	New Weapons Dev.Lect.	---
	Total	17-4		Total	16-6

Intersessional Field Trip.

Second Year (OT2)

Summer Term			Fall Term		
Mt-301(A)	High Temp., Materials	3-0	Ma-106(A)	Compl.Var.& LaPlace Tr.	4-0
EE-551(B)	Trans. Lines & Filters	3-2	EE-755(A)	Electronic Control & Measure	3-4
EE-751(C)	Electronics	3-4			
Ae-501(A)	Hydro-aero-mechanics,I	4-0	ME-141(C)	Eng. Thermo.	4-2
Or-152(C)	Underwater Ord.	2-0	Ae-502(A)	Hydro-aero-mechanics	4-0
			IE-101	Prins. of Indus. Org.	---
	Total	15-6		Total	15-6

Second Year (OT2) (Cont'd)

Winter Term			Spring Term		
EE-671(A)	Transients	3-4	EE-672(A)	Servomechanisms	3-4
Ch-581(A)	Special Fuels, Chem of	2-2	Ch-541(A)	Reaction Motors	2-2
ME-142(A)	Eng Thermo	2-2	ME-143(A)	Eng. Thermo.	4-4
Mt-203(B)	Physical Metallurgy (Sp. Topics)	2-2	ME-310(B)	Heat Transmission	3-2
Ae-503(A)	Compressibility	4-0	IE-104	Psychophysical Sys.Res	---
IE-103	Applied Indus. Org.	---	SL-102	New Weapons Dev.Lect.	---
SL-101	New Weapons Dev.Lect.	---		Total	12-12
	Total	13-10			

Intersessional Field Trip

Third Year (OT3)

At M I T

Fall Term		Spring Term	
16.40	Space Kin & Gyr. Inst. Th	16.42	F.C. Inst. Adv.
16.41	Intro. to F.C. Instr.	2.287	Rotating Fluid Machy.
16.43	F.C. Instr. Lab.		Thesis
2.213	Gas Turbines		
	Thesis		

ORDNANCE ENGINEERING

Subsurface Ordnance Curriculum - OW Groups.

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above

First Year (OW)

Summer Term			Fall Term		
Ma-101(C)	Intro to Eng. Math	5-0	Ma-102(C)	Diff. Equ. and Series	5-0
Mc-101(C)	Statics & Kinematics	3-0	Ph-141(B)	Analytical Mechanics	4-0
EE-151(C)	DC Cir. & Fields	3-4	EE-251(C)	A.C. Circuits	3-4
Ch-101(C)	Genl Inorganic Chem	3-2	Ae-100(C)	Basic Aerodynamics	3-4
Or-120(C)	Surface Fire Control	2-0			
	Total	16-6		Total	15-8

First Year (OW) - Subsurface Ordnance - (Cont'd.)

Winter Term			Spring Term		
EE-451(C)	Transformers & Synchros	2-2	EE-455(C)	Syncs. Motors	2-2
Es-261(C)	Electron Tubes & Cir.	3-2	Es-262(C)	Electron Tubes & Cir.	3-2
Ma-103(B)	Func. of Several Var. & Vector Anal.	5-0	Ma-104(A)	Partial Diff. Eq & Related Topics	5-0
SL-101	New Weapons Dev.Lect.	---	Or-151(C)	Underwater Ordnance	2-0
Ph-142(B)	Analytical Mechanics	4-0	Ph-540(B)	Kinetic Theory & Stat. Mech.	3-0
	Total	14-4	SL-102	New Weapons Dev Lect.	---
			OR-110(C)	Ord. Admin	2-0
				Total	17-4

Intersessional Field Trip.

Second Year (OW2)

Summer Term			Fall Term		
Ph-250(C)	Optics, Geom.& Phys.	3-2	Ae-502(A)	Hydro-aero-mechanics II	4-0
Ae-501(A)	Hydro-aero-mechanics	4-0	Ma-106(A)	Compl.Var. & LaPlace Tr.	4-0
EE-551(B)	Trans.Lines & Filters	3-2	Me-141(C)	Eng Thermo	4-2
Or-152(C)	Underwater Ord	2-0	EE-755(A)	Electronic Con & Meas.	3-4
Ph-421(A)	Fundamental Acoustics	3-0	Ph-422(A)	Applied Acoustics	3-0
	Total	15-4	IE-101	Prins of Indus. Org	---
				Total	18-6

Winter Term			Spring Term		
EE-671(A)	Transients	3-4	EE-672(A)	Servomechanisms	3-4
Me-142(A)	Eng. Thermo.	2-2	EE-753(C)	Electronics	1-2
Ph-423(A)	Underwater Acoustics	2-3	ME-143(A)	Eng. Thermo	4-4
Ph-610(B)	Atomic Physics	3-0	Ph-424(A)	Sonar Systems & Dev	2-3
IE-103	Applied Indus. Org	---	IE-104	Psychophysical Sys Res.	---
SL-101	New Weapons Dev. Lect.	---	SL-102	New Weapons Dev. Lect.	---
	Total	10-9		Total	10-13

Intersessional Field Trip.

Third Year (OW3)
At U.C.L.A.
(Tentative)

Fall Term		Spring Term	
Ph 214	Adv. Acoustics	Ph 110	Elect. & Mag.
Ph 112	Thermodynamics	Ph 264	Acoustics Seminar
Ph 266A	Prop. of Waves in Fluids	Ph 266B	Prop of Waves in Fluids
Ph 220A	Theoretical Mech.	Ph 220B	Theoretical Mech.
Ph 114C	Mech. of Wave, Motions & Sound	Ph 290B	Research
Ph 290A	Researxh		

Special Physics Ordnance Curriculum - OX Groups

Objective

The objective of this curriculum is to prepare officers for duties in connection with research and development in the ordnance specialization indicated above.

First Year (OX)

Summer Term

Ma-181(C)	Part.Dev.and Ord.Diff Equations	5-0
Mc-101(C)	Statics & Kinematics	3-0
EE-151(C)	D.C Circuits& Fields	3-4
Ch-101(C)	Gen.Inorganic Chem.	3-2
Or-120(C)	Surface Fire Control	2-0
	Total	16-6

Fall Term

Ma-182(B)	Vector Analysis	5-0
EE-251(C)	A.C. Circuits	3-4
Ph-141(B)	Analytical Mechanics	4-0
Ma-106(A)	Compl.Var.& LaPlace Tr.	4-0
Or-131(C)	A.A. Fire Control	1-2
	Total	17-6

Winter Term

Ma-183(B)	Complex Variables	5-0
EE-451(C)	Transformers & Synchros	2-2
Es-113(C)	Circuit Anal. & Meas.	3-3
Es-261(C)	Electron Tubes & Cir.	3-2
SL-101	New Weapons Dev.Lect.	---
Ph-142(B)	Analytical Mechanics	4-0
	Total	17-7

Spring Term

Ma-184(A)	Spec.Math.Methods of Physics	5-0
EE-651(B)	Servomechanisms & Transients	3-4
Es-114(C)	Circuit Anal.& Meas.	3-3
Es-262(C)	Electron Tubes & Cir.	3-2
SL-102	New Weapons Dev.Lect.	---
	Total	14-9

Second Year (OX2)

At M.I.T.

Summer Term

First Half

8.07 Thermo and Statist Mech
8.05N Atomic Physics

Second Half

8.06N Nuclear Physics
8.08 Electronics

Fall Term

6.20 Elect. Cont. and Meas
8.71 Int. to Theo. Physics
6.633 Electronic Circuit Theory
6.80 Elec. Meas. Lab.
L17 Scientific German

Spring Term

8.101 Experimental Physics II
8.72 Int. to Theo Physics II
6.623 Pulse Circuits, Prin
6.624 Electrodyn. of Particles

Intersessional Field Trip

Third Year (OX3)

At M.I.T.

Fall Term		Spring Term	
8.231	Elec. Discharges in Gases	8.512	Nuclear Physics II
8.511	Nuclear Physics I	8.513	Nuclear Physics Lab.
8.57	Int. to Nuclear Engineering		Thesis
8.68T	Spec. Prob. in Nuclear Physics		

RADIOLOGICAL DEFENSE ENGINEERING

Radiological Defense Engineering Curriculum - RZ Groups.

Objective

The objective of this curriculum is to train officers of the Armed Services in the fundamental sciences especially in those pertaining to nuclear and medical physics and in those associated with the problems that arise from the application of atomic energy.

First Year (RZ)

Summer Term			Fall Term		
Ma-181(C)	Partial Deriv. & Ord. Diff. Eqs.	5/0	Ma-182(B)	Vector Anal	5-0
Ph-240(C)	Geom.& Phys. Optics	3-3	Ph-141(B)	Analytical Mechanics	4-0
Ch-102(C)	Gen. Inorganic Chem.	4-2	Ph-341(C)	Electricity & Magnetism	4-2
Mr-101(C)	Atmosph. Circulation	3-0	Ch-213(C)	Quantitative Analysis	3-4
	Total	15-5		Total	16-6

Winter Term			Spring Term		
Ma-183(B)	Complex Var.	5-0	Ma-184(A)	Spec. Math. Method of Physics	5-0
Ph-342(B)	Electricity & Magnet	3-3	Ph-343(B)	Electricity & Magnet	3-0
Ph-142(B)	Analytical Mechanics	4-0	Ph-640(B)	Atomic Physics	3-3
Ch-315(C)	Organic Chem.	3-4	Ch-442(C)	Physical Chem.	4-2
	Total	15-7	Ph-540(B)	Kinetic Theory of Gases	3-0
				Total	18-5

Radiological Defense Engineering Curriculum - RZ Groups. (Cont'd.)

Second Year (RZ2)

At University of California

Summer Term

First Session

Zoology 1A - General Zoology
Physiology
1A - General Physiology

Second Session

Physiology 113

Fall Term

Phys. 121 Intro. to Atomic Structure
Phys. 128L Radiation Meas.
Chem. 123 Nuclear Chemistry
Physiology General & Comparative
100A Physiology
Pharmacology 142

Spring Term

Phys. 124 Radioactivity & Nuclear Struct.
Phys. 126 Medical Physics
Biochem
103 Animal Biochemistry
Biochem
206 Bacteriology
Phys. 126L Biological Applicationa. of Artificial Radioactivity

Intersessional Field Trip.

Third Year (RZ3)

At University of California

Fall Term

Phys. 215A Adv. quantum Mech & Nuclear Physics
Phys. 290 Biophysics & Med. Phy.
Physiology Public Health
Elective

Spring Term

Phys. 215B Quantum Mech. & Nuclear Physics
Phys. 290 Biophysics & Nuclear Seminar
Phy. 295 Research
Elective

Final Comprehensive Exam.

Second Year (RZ2)

At Ohio State University

Summer

Zoology	401	General Zoology
Physics	726	Methods of Theoretical Physics
Physics	727	Methods of Quantum Mechanics I
Bacteriology	607	General Bacteriology

Autumn

Physics	721	Nuclear Physics
Physics	740	Introduction to Theoretical Physics
Physiology	601	Advanced Physiology
Anatomy		Histology

Winter

Physics	741	Introduction to Theoretical Physics
Physics	633	Nucleonic Measurements and Instrumentation
Physiology	602	Advanced Physiology
Chemistry	795	Colloid Chemistry

Spring

Physics	613	Electromagnetic Field Phenomena
Physiology	646	Radiation Physiology
Physiology	603	Advanced Physiology

Intersessional Field Trip.

At Ohio State University

Autumn

Physics	720	Xrays and Atomic Structures
Physics	950	Research in Physics
Physiology	628	Physical Chem. Biology

Winter

Physics	820	Theory of the Atomic Nucleus
Physics	950	Research in Physics
Elective		

Spring

Physics	821	Theory of the Atomic Nucleus
Physics	950	Research in Physics
Physiology	645	Biophysics

PART III

Course Descriptions

DESCRIPTIVE NAME OF COURSE IS FOLLOWED BY TWO NUMBERS, SEPARATED BY A HYPHEN. THE FIRST NUMBER IS CLASSROOM HOURS, THE SECOND LABORATORY HOURS

AERONAUTICS

Ae Courses

Aeronautical Lecture Series	Ae-001 (C)
Basic Aerodynamics	Ae-100 (C)
Technical Aerodynamics	Ae-121 (C)
Technical Aerodynamics - Performance	Ae-131 (C)
Flight Analysis	Ae-132 (B)
Aircraft Performance - Flight Analysis	Ae-136 (B)
Dynamics I	Ae-141 (A)
Dynamics II	Ae-142 (A)
Dynamics III	Ae-146 (A)
Stress Analysis	Ae-201 (C)
Stress Analysis	Ae-202 (C)
Stress Analysis	Ae-203 (A)
Stress Analysis	Ae-204 (A)
Airplane Design	Ae-311 (C)
Airplane Design	Ae-312 (B)
Advanced Aircraft Structures	Ae-321 (A)
Aircraft Engines	Ae-411 (B)
Aircraft Propulsion	Ae-421 (B)
Internal Flow in Aircraft Engines	Ae-431 (A)
Gas Turbines I	Ae-451 (C)
Gas Turbinee II	Ae-452 (C)
Hydro-aero-mechanics	Ae-501 (A)
Hydro-aero-mechanics	Ae-502 (A)
Compressibility	Ae-503 (A)

Ae-001(C) AERONAUTICAL LECTURE SERIES 0-2

Lectures by prominent authorities from the Bureau of Aeronautics research laboratories, and from industry.

Prerequisites: None.

Ae-100(C) BASIC AERODYNAMICS 3-4

Properties of fluids; statics of fluids; flotation; Bernoulli's theorem fluid velocity and pressures; pitotstatic tube; the venturi tube; cavitation; theory of lift; circulation, blade screws and propellers vicosity; viscous flows; vortices; flow in pipes; flow through orifices; laminar and turbulent boundary layer flows; separation phenomena: surface friction: resistance of floating bodies; dynamics of compressible fluids.

The P.W. periods include experimental work in the wind tunnel, allied to the topics above; technical analysis and report writing.

Texts: Fluid Mechanics; Dodge, Thompson: Elementary Fluid Mechanics Rouse.

Prerequisites: None.

Ae-121(C) TECHNICAL AERODYNAMICS 3-2

Characteristic flows and pressures about bodies; surface friction wake drag; aerodynamic characteristics of airfoil sections, three dimensional air foil theory; induced drag; aspect ratio corrections biplanes; interference drag high lift devices; velocity polar; relative motion.

The P.W. periods include wind tunnel experiments, analysis and technical report writing on topics allied to the above class work.

Texts: Airplane Design - Performance; Warner: Engineering Aerodynamics, Diehl: Elementary Applied Aerodynamics; Hemke. Wind Tunnel Testing. Pope

Prerequisites: Ae-100(C)

Ae-131(C) TECHNICAL AERODYNAMICS - PERFORMANCE 4-2

The aerodynamic characteristics of the airplane; the propeller and engine characteristics; sea level performance, performance at altitudes, superchargers, range and endurance, special performance problems, charts.

The P.W. periods are devoted to computations and performance analysis.

Texts. Same as in Ae-121(C).

Prerequisites: Ae-100(C), Ae-121(C)

Ae-132(B) FLIGHT ANALYSIS 3-2

Parametric study of aircraft performance, flight test procedure flight data reduction special flight problems.

Practical work: Practical problems dealing with the above.

Texts: Airplane Design - Performance; Warner: Engineering Aerodynamics Diehl. Flight Testing; Hamlin.

Prerequisites: Ae-100(C), Ae-121(C), Ae-131(C).

Ae-136(B) AIRCRAFT PERFORMANCE - FLIGHT ANALYSIS 3-2

Aerodynamic characteristics of composite aircraft; propeller and engine characteristics; aircraft performance; range and endurance; special performance problems; performance parameters; flight test reduction and analysis.

Practical work: Analysis of performance of an aircraft will be made based upon wind tunnel tests in the laboratory - practical problems from flight test will also be analyzed.

Texts: Airplane Design - Performance; Warner: Engineering Aerodynamics; Diehl: Elementary Applied Aerodynamics; Hemke: Wind Tunnel Testing; Pope: Flight Testing; Hamlin.

Prerequisites: Ae-100(C), Ae-121(C)

Ae-141(A) DYNAMICS, I 3-4

Fundamental definitions, the forces and moments of the entire airplane, the equations of motion, the moments of the wing, tail and other parts of the airplane, C.G. location on static stability, neutral points, maneuver points, fixed control and free control stability, elevator, aileron rudder effectiveness, control design festures, maneuverability and controllability, turns and loops.

The laboratory work consists of wind tunnel experimentation and analysis of the above topics on models

Texts: USNPS Notes; Higgins: Aircraft Stability and Controllability; Perkins: Flight Testing; Hamlin.

Prerequisites: Ae-100(C), Ae-121(C), Ae-131(C).

Ae-142(A) DYNAMICS, II 3-4

The Eulerian equations of motion, the moments of inertia of aircraft, the aerodynamic reactions and derivatives solution of the symmetrical or longitudinal motion, analysis of the longitudinal motion, solution of the asymmetrical or lateral motion, analysis of the lateral motion, effect of control freedom, effect of controls and response, spins.

The laboratory works consists of wind tunnel experimentation on models to study some of the above problems

Texts: Same as in Ae-141(A)

Prerequisites: Ae-141(A)

Ae-146(A) DYNAMICS 3-2

Fundamental definitions, forces and moments of composite aircraft, equations of motion, static stability and trim, effects of CG location, static margins, free control stability, dynamical longitudinal stability, dynamic lateral stability, force and moment derivations, stability charts, controllability, maneuverability, three dimensional motions, spins.

The P.W. consists of experimentation and analysis of static and dynamic stability of some particular aircraft.

Texts: Same as in Ae-141(A).

Prerequisites: Ae-100(C), Ae-121(C), Ae-131(C) or Ae-136(B)

Ae-201(C) STRESS ANALYSIS 4-2

The course is in continuity with ME-500, and emphasizes diagrammatic methods, applied especially to: analysis of beam including statically indeterminate cases, frame elements, variable cross section, shearing effect on bending displacement; plane stress, principal stresses; influence lines and elementary applications.

Texts: Strength of Materials Vol. I; Timoshenko: Airplane Structures Vol. I; Niles, Newell: Analysis and Design of Airplane Structures; Bruhn: USNPS Stencils.

Prerequisites: Ma-102(C) STRESS ANALYSIS 4-2

This course is in continuity with Ae-201(C) and considers: strain energy, applications to impact loading, Castigliano theorem, displacement calculations, redundant trusses; virtual energy, applications to deflection and statically indeterminate problems, Maxwell-Mohr method; law of reciprocal deflections; influence line application to deflections; buckling of bars, the flexible column, critical loads, energy methods; curved bars.

Texts: Strength of Materials Vols. I and II; Timoshenko: Airplane Structures Vols. I and II; Niles, Newell: Analysis and Design of Airplane Structures; bruhn: USNPD Stencils.

Prerequisites: Ae-291(C)

Ae-203(A) STRESS ANALYSIS 4-0

This course is in continuity with Ae-202(C) and considers: curved bars (continued), rotating machine parts circular bars in bending and/or twist, energy methods on curved frames, beams loaded by forces not in principal axes of section, cases with unsymmetrical cross-section; short beams in compression and bending, cores; torsion non-circular sections, membrane analogy, combined with bending, close soiled helical spring, crank throw, thin open or hollow sections, torsional shear flow; center of twist, shear flow; beam columns, single panel, multipanel, charts; beam tie; polar diagrams.

Texts: Same as in Ae-202(C)

Prerequisites: Ae-202(C), Me-111

Ae-203(A) STRESS ANALYSIS 4-0

This course is in continuity with Ae-203(A) and considers: Thin stiff plates under lateral load, bent to cylinder, in pure bending in two perpendicular directions, axially symmetrical problems: axially symmetrical membrane problems; discontinuity effects in shells, beam on elastic foundation and application, cylinder and hemisphere flat plate and cylinder, hollow ring and cylinder; thick-walled spheres and cylinders, applications to rotating discs; selected topics from theory of elasticity; stress concentration.

Texts: Strength of Materials, Vol. I and II, Timoshenko; Airplane Structures, Vol. I and II, Niles and Newell; Analysis and Design of Airplane Structures; Bruhn: Airplane Structural Analysis and Design, Sechler and Dunn: USNPS Stencils.

Prerequisites: Ae-203(A).

Ae-311(C) AIRPLANE DESIGN, I 2-4

Topics are: Critical loading conditions, load-factors, V-g diagrams, strength envelopes, detail methods of layout and analysis of a light plane,

P.W. requirements are for the condition of high angle attack: prepare equipment list and balance diagram; correct airfoil characteristics for structural use; construct three view drawing; run the balance calculation and the preliminaries to the wing design.

Texts: Same as Ae-202(C) and Airplane Design Manual Teichmann. Airplane Structural Analysis and Design; Sechler and Dunn C.A.R. 04; C.A.M. 04. Navy Specifications and Manuals.

Prerequisites: Ae-202(C)

Ae-312(B) AIRPLANE DESIGN, II 2-4

Topics include: wing spar analysis wing truss analysis, fuselage analysis including Maxwell Diagram; design of one wing spar on basis (a) shearresistant web, (b) tension field web (c) composite spar of two materials; design of elevator torque tube in bending and twist for given loading condition, design of several members of the fuselage truss as columns and as ties; design of indicated fittings.

Texts: Same as in Ae-311(C), Ae-203(A)

Prerequisites: Ae-311(C), Ae-203(A)

Ae-321(A) ADVANCED AIRCRAFT STRUCTURES 4-0

Topics include: rectangular plates in pure bending, in bending and under loading in middle surface, buckling, crippling advanced deflection problems, Williot diagram; deformation in the plastic state; advanced stability considerations, beam columns rings and tubes, latticed columns variable section torsional cases.

Texts: Those of Ae-204(A) and Ae-311(C)

Prerequisites: Ae-312(B), Ae-204(A)

Ae-411(B) AIRCRAFT ENGINES 3-2

This course extends the study of combustion with particular reference to piston engine and gas turbine applications. Fuel mixtures, ignition, flame propogation and stability are discussed. Utilization and conversion and mechanical aspects. The latter is continued in a survey of current engine design and construction.

Texts: Internal Combustion Engines; Lichty Internal Combustion Engines; Taylor & Taylor: USNPS Stencils.

Prerequisites: ME-132(C)

Ae-421(B) AIRCRAFT PROPULSION 3-2

Sea level and altitude performance characteristics of piston engines, propellers, turbo-jet and turbo-prop engines are analized. Maximum performance, cruise control, laboratory and flight testing, and test data correction methods are discussed. Aircraft performance is reviewed with particular reference to the propulsion system. The practical work of this course consists of supervised analysis of test data taken at various Naval Air Test Centers.

Texts: Aircraft Power Plants; Fraas: Airplane Propeller Principles; Nelson: Jet Propulsion; Air Technical Service Command: USNPS Stencils.

Prerequisites: Ae-411(B), Ae-131(C).

Ae-431(A) INTERNAL FLOW IN AIRCRAFT ENGINES 4-0

Momentum theorem, thrust equations, gas turbine cycle analysis, flow equations, relative and absolute flow, relative flow in machines, energy equations, thermodynamic flow equations, axial-flow compressors, centrifugal compressors, axial-flow turbines, centrifugal turbines, control analysis of aircraft gas turbines.

Texts: Jet Propulsion; ATSC: Jet Propulsion and Gas Turbines; Zucrow: USNPS Stencils.

Prerequisites: Ae-503(A)

Ae-451(C) GAS TURBINES I 3-0

A seminar on the theory, design and control of gas turbines, stationary and marine.

Prerequisites: ME-132(C), Ae-502(A)

Ae-452(C) GAS TURBINES II 3-0

A seminar in continuation of Ae-451(C).

Prerequisites: Ae-451(C).

Ae-501(A) HYDRO-AERO-MECHANICS. 4-0

Vector Calculus and aerodynamical applications, fluid kinematics and flow description, stream and velocity potential functions, dynamic equations for a perfect fluid, solution by scalar and vector methods, properties of elemental and combined flows, two dimensional problems, use of complex numbers in flow description, conformal transformation, complex integration, Blasius Equations, Kutta-Joukowski Theorem, lift and pitching moment on an infinate wing.

Texts: Airfoil and Airscrew Theory; Glauert: Fluid Dynamics; Streeter.

Prerequisites: Ae-131(C)

Ae-502(A) HYDRO-AERO-MECHANICS, II 4-0

Viscous Fluids, Navier-Stokes Equation and special solutions, Prandtl Boundary Layer Theory, skin friction, Helmholtz Vortex Theory, the three dimensional airfoil, induced velocity, angle of attack, drag, lift distribution, least induced drag, tapered and twisted airfoils, chordwise and spanwise load distribution, tunnel-wall effect, compressible fluids.

Texts: Same as Ae-501(A)

Prerequisites: Ae-501(A)

Ae-503(A) COMPRESSIBILITY 4-0

Propagation of disturbances, Normal shocks, Flow in channels with varying cross section, Laval nozzle with varying back pressure, Oblique shocks, Reflection of shock fronts, Mach waves, Prandtl-Meyer Flow, Hodograph methods, Method of characteristics, Travelling shock fronts, Instationary flow problems.

Texts: Aerodynamics of a compressible Fluid; Liepman, Puckett; USNPS Stencils.

Equati
Prerequisites: ME-132(C), Ae-502(A).

CHEMISTRY

Ch Courses

General Inorganic Chemistry	Ch-101(C)
General Inorganic Chemistry	Ch-102(C)
Fuel and Oil Chemistry	Ch-111(A)
General and Petroleum Chemistry	Ch-121(B)
Quantitative Analysis	Ch-213(C)
Qualitative Analysis	Ch-221(C)
Quantitative Analysis	Ch-231(C)
Organic Chemistry	Ch-301(C)
Organic Chemistry	Ch-311(C)
Organic Chemistry	Ch-312(C)
Organic Chemistry	Ch-315(C)
Organic Qualitative Analysis	Ch-321(A)
Organic Chemistry, Advanced	Ch-322(A)
The Chemistry of High Polymers	Ch-323(A)
Physical Chemistry	Ch-411(C)
Physical Chemistry	Ch-412(C)
Physical Chemistry (Adv.)	Ch-413(A)
Physical Chemistry	Ch-442(C)
Plastics	Ch-521(A)
Physical Chemistry of Metallurgy	Ch-531(A)
Reaction Motors	Ch-541(A)
Radio Chemistry	Ch-551(A)
Physical Chemistry	Ch-561(A)
Chemistry of Special Fuels	Ch-581(A)
Thermodynamics	Ch-611(C)
Thermodynamics	Ch-612(C)
Chemical Engineering Thermodynamics	Ch-613(A)
Thermodynamics	Ch-631(A)
Chemical Engineering Calculations	Ch-701(C)
Chemistry Seminar	Ch-800(A)

Ch-101(C) GENERAL CHEMISTRY 3-2

The subject matter includes a consideration of general chemical principles such as the modern concept of the atom kinetic theory, chemical equilibrium, chemical calculations reaction rates and a brief discussion of specialized topics (corrosion, explosives etc.) which are of interest to officers in the naval services

The laboratory work consists of experiments selected to illustrate principles discussed in the lecture

Text: Principles of Chemistry; Hildebrand

Prerequisites: None.

Ch-102(C) GENERAL INORGANIC CHEMISTRY 4-2

This course deals with the properties of substances and their atomic and molecular structure, weight relations in chemical reactions, valence, electronic structure and oxidation-reduction reactions. Theoretical topics considered include the properties of gases reaction rates and chemical equilibrium.

The laboratory work consists of experminents in qualitative analysis on a semimicro scale, illustrating reactions and principles discussed in the lectures.

Texts: General Chemistry; Pauling Introduction to Semimicro Qualitative Analysis; Curtman.

Prerequisites: None.

Ch-111(A) FUEL AND OIL CHEMISTRY 2-2

The subject matter includes the chemistry properties and production of fuels and lubricants; the theory of combustion and knocking, the theory of fluid film and boundary lubrication the significance of tests on petroleum products and problems on the analysis of Orsat data and stoichiometry of combustion.

The laboratory work includes conducting some of the standard tests on fuels and lubricants and problems on interpretation of data from Orsat analysis and combustion calculations

Texts: Chemical Technology or Petroleum Gruse and Stevens. Significance of Tests on Petroleum Products A S T M. Fed Spec.VV-L791 b

Prerequisites: Ch-101(C).

Ch-121(B) GENERAL AND PETROLEUM CHEMISTRY 4-2

The subject matter includes a consideration of chemical principles such as atomic structure, states of matter ionization, chemical equlibria, etc.; and a survey of the chemistry properties and production of fuels and lubricants. The theories of combustion, knocking and lubrication are presented. Study is made of the interpretation of results of standard test procedures and Orsat analysis. The laboratory work consists of experiments illustrating principles discussed in the lectures; and performing some of the standard tests on fuels and lubricants

Texts: Principles of Chemistry; Hildebrand Chemical Technology of Petroleum; Gruse and Stevens, Significance of Tests on Petroleum Producers, A.S.T.M.; Federal Specifications for Lubricants and Liquid Fuels, VV-L-791b.

Ch-213(C) QUANTITATIVE ANALYSIS 3-4

This course deals with the theoretical principles underlying analytical chemical methods, and the calculations involved in quantitative determinations.

The laboratory work consists of typical volumetric and gravimetric determinations.

Text: Quantitative Analysis, Peirce and Haenisch

Prerequisites: Ch-102(C).

Ch-221(C) QUALITATIVE ANALYSIS 3-2

This is the first part of a course in analytical chemistry and includes the treatment of the theory of ionization, chemical equilibrium, solubility product, complexion formation and oxidation reduction reactions, as they apply to qualitative analysis

The laboratory work consists of the separation and detection of selected ions on a semimicro scale

Text: Introduction to semimicro Qualitative Analysis Curtman

Prerequisites: Ch-101(C) or Ch 121)B)

Ch-231(C) QUANTITATIVE ANALYSIS 2-4

This course is a continuation of Ch-221 and deals with the theoretical principles and calculations involved in quantitative analysis.

The laboratory work consists of typical volumetric and gravimetric determinations.

Text: Quantitative Analysis: Pierce and Haenisch

Prerequisites: Ch-101(C) or Ch-121(B); Ch-221(C).

Ch-301(C) ORGANIC CHEMISTRY 3-2

This course deals with the properties, reactions and relationships of the principal classes of organic compounds, a brief summary of aliphatin and aromatic compounds.

The laboratory work includes both preparative experiments and experiments illustrating reactions discussed in the lectures.

Text: Organic Chemistry; Fuson and Snyder

Prerequisites: Ch-101(C) or Ch-121)B)

Ch-311(C) ORGANIC CHEMISTRY 3-2

The first half of a course in organic chemistry integrating the study of the properties and reactions of aliphatic and aromatic compounds

The laboratory work is designed to illustrate important reactions of organic compounds.

Text: POrganic Chemistry; Fuson and Snyder

Prerequisites: Ch-101(C); Ch-111(A).

Ch-312(C) ORGANIC CHEMSITRY 3-2

The second half of a course in organic chemistry following Ch-311(A) organic synthetic methods are emphasized

The laboratory work includes the preparation of selected organic compounds.

Texr: Organic Chemistry; Fuson and Snyder

Prerequisites: Ch-311(C)

Ch-315(C) ORGANIC CHEMISTRY 3-4

This course deals with the properties, reactions and relationships of the principal classes of organic compounds, as a basis for work in the biological sciences.

The laboratory work furnishes descriptive material illustrating reactions discussed in the lectures.

Text: Organic Chemistry; Fuson and Snyder.

Prerequisites: Ch-102(C); Ch-213(C).

Ch-321(A) QUALITATIVE ORGANIC ANALYSIS 2-2

This course consists of the identification of organic compounds on the basis of physical properties, solubility behavior, classification reactions and the preparation of derivatives.

Text: Identification of Organic Compounds; Shriner and Fuson.

Prerequisites: Ch-301(C); Ch-312(C) or Ch-315(C).

Ch-322(A) ADVANCED ORGANIC CHEMISTRY 3-2

This course is concerned principally with reactions involved in the synthesis of organic compounds, with particular attention to reaction mechanisms and electronic explanations of the behavior of organic compounds.

Text: Organic Chemistry; Fuson and Snyder.

References: Electronic Interpretation of Organic Chemistry; Remick.
Theory of Acids and Bases; Luder and Zuffont.

Prerequisites: Ch-301(C); Ch-312(C) or Ch-315(C)

Ch-323(A) THE CHEMISTRY OF HIGH POLYMERS 3-0

This course deals with the synthetic and structural aspects of high polymer chemistry, and includes discussion of both synthetic and natural high polymers.

Text: Chemistry of Plastics and High Polymers; Ritchie.

Prerequisites: Ch-301(C); Ch-312(C) or Ch-315(C); Ch-512(A).

Ch-411(C) PHYSICAL CHEMISTRY 3-2

This course involves a study of the physico-chemisal properties of matter and the laws governing chemical behavior Topics include gases, solids, molecular structure, thermodynamics thermochemistry liquids and solutions.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures.

Text: Outlines of Physical Chemistry, Daniels Experimental Physical Chemistry, Daniels, Mathews and Williams

Prerequisites: Ch-101(C) or Ch-121(B).

Ch-412(C) PHYSICAL CHEMISTRY 2-2

This course is a continuation of Ch-411 Topics include chemical equilibrium, chemical kinetics electrical conductance electromotive force. colloids and atomic and nuclear structure.

The laboratory work consists of experiments designed to illustrate principles discussed in the lectures.

Text: Outlines of Physical Chemistry, Daniels: Experimental Physical Chemistry; Daniels, Mathews and Williams.

Prerequisites: Ch-411(C).

Ch- 413(A) ADVANCED PHYSICAL CHEMISTRY 2-2

A graduate course in selected topics in physical chemistry. Electronic configurations, dipole moments, physical chemistry of the solid state and the liquid state, etc.

The laboratory work consists of experiments designed to supplement the material covered in the classroom.

Prerequisites: Two terms of physical chemistry one term of thermodynamics.

Ch-442(C) PHYSICAL CHEMISTRY 4-2

This course involves a study of the laws governing the chemical behavior and the physico-chemical properties of matter. Some of the topics considered are gases, liquids, solids solutions thermochemistry, chemical thermodynamics, chemical equilibrium, chemical kinetics, electrochemistry and colloids.

Problems are assigned and laboratory experiments are performed to illustrate the principles discussed in the lectures.

Text: Outlines of Physical Chemistry Daniels Experimental Physical Chemistry; Daniels, Mathews and Williams

Prerequisites: Ch-101(C) or Ch-102(C)

Ch-521(A) PLASTICS 3-2

The subject matter includes a study of the nature and types of plastics, their properties, applications, and limitations as an engineering material, Natural and synthetic rubbers are included.

The laboratory exercises consist of the preparation of typical plastics, a study of their physical and chemical properties, and identification tests.

Text: Fundamentals of Plastics; Richardson and Wilson.

Prerequisites: Ch-101(C) or Ch-121(B)

Ch-531(A) PHYSICAL CHEMISTRY OF METALLURGY 2-0

A continuation of the study of physical chemistry, emphasizing certain aspects of particular importance in metallurgy. Chemical equilibria in reduction processes, in deoxidation, and in carburizing-decarburizing; principles of controlled atmospheres; activity and activity coefficients in metal solutions; concentration gradients and diffusion effects. Numerical problems form an integral part of the course.

Prerequisites: Ch-412(C) or CH-421 , and Mt-202(C).

Ch-541(A) REACTION MOTORS 2-2

The subject matter includes the theory and design of rocket motors and thermal jet engines, nozzles, solid and liquid propellants and the applications of these devices to military uses. Numerical problems form an integral part of the course.

Text: Rocket Propulsion Elements; Sutton.

Prerequisites: One term of Thermodynamics.

Ch-551(A) RADIOCHEMISTRY 3-0

A seminar course with discussions on the important aspects of radioactivity from the standpoint of the chemical transformations which accompany it and which it may induce; the possible health hazards associated with radioactivity, safety measures and decontamination problems; techniques for measurement and study of ionizing radiation.

Prerequisites: M None.

Ch-561(A) PHYSICAL CHEMISTRY 3-2

This is a fundamental course in physical chemistry for students who are non chemistry majors. The subject matter includes topics such as gases, liquids, solutions, thermochemistry, chemical thermodynamics, with particular emphasis placed on chemical equilibrium and chemical kinetics. Numerical problems on gas mixtures, combustion calculations, equilibria in combustion products, flame temperatures etc., form an integral part of the course.

The laboratory work consists of experiments illustrating principles discussed in the lectures

Text: Outlines of Physical Chemistry, Daniels. Experimental Physical Chemistry, Daniels, Mathews and Williams

Prerequisites: Ch-111(A) or 121(B)

Ch-581(A) CHEMISTRY OF SPECIAL FUELS 2-2

A brief survey of the organic and physical chemistry necessary for an appreciation of the problems associated with special fuels. The nature of conventional fuels and of high-energy fuels, their limitations, and possible future developments, methods of reaction rate control; etc.

Prerequisites: None.

Ch-611(C) THERMODYNAMICS 3-2

A study of the fundamentals of thermodynamics, the concept of energy and transformations, thermodynamic properties of substances, ideal gases; thermochemistry. Numerical problems form an integral part of the course.

Text: Principles of Engineering Thermodynamics 2nd Ed. Kiefer, Stewart and Kinney. Introduction to Chemical Engineering Thermodynamics; Smith. Chemical Engineers Handbook, Perry Thermodynamic Properties of Steam; Keenan and Keyes Gas Tables Keenan and Kaye

Prerequisites: Ch 101(C)

Ch-612(C) THERMODYNAMICS 3-2

A continuation and extension of Ch 611 with application of the principles of thermodynamics to the unit operations and unit processes of chemical engineering practice. Numerical problems are used extensively in illustrating principles

Text: Introduction to Chemical Engineering Thermodynamics; Smith. Chemical Engineering Handbook; Perry Thermodynamics Properties of Steam, Keenan and Keyes. Gas Tables; Keenan and Keyes

Prerequisites: Ch-611(C)

Ch-613(A) CHEMICAL ENGINEERING THERMODYNAMICS 3-2

The subject matter is an extension of previous studies in mechanical thermodynamics to include the thermodynamic analysis and solution of chemical engineering problems. It is designed for non-chemical majors. The course includes a specialized treatment of the thermal and thermodynamic properties of materials, thermo-chemistry, equilibrium and the phase rule; phase relations; chemical equilibria and energy relations, particularly at higher temperatures and pressures. Strong emphasis is placed on numerical or quantative application of principles by solution of problems.

Text: Introduction to Chemical Engineering Thermodynamics; Smith. Chemical Engineers Handbook Perry

Prerequisites: One term of Physical Chemistry and one term of Thermodynamics.

Ch-632(A) THERMODYNAMICS 3-2

An abbreviated intensive course in the basic concepts of thermodynamics and their application to ordnance problems. The subject matter includes the study of the thermal properties and energy relations of explosion products, stochiometrical relations, chemical equilibria at high temperature, etc. This course supplies a prerequisite for subsequent study of rocket motors or interior ballistics.

Numerical problems concerning the behavior of various types of propellants and explosives are used to illustrate the basic theory and methods developed in the classroom.

Text: Thermodynamics of Firearms, Robinson.

Prerequisites: Ch-101(C), or equivalent.

Ch-701(C) CHEMICAL ENGINEERING CALCULATIONS 3-2

This course is especially designed to develop facility in the recognition and solution of engineering problems involving mass and energy relationships in chemical and physical-chemical reactions. Problems based on combustion, distillation, absorption, evaporation, crystallization, humidification and other unit operations and processes are dealt with. Problems are chosen from engineering practice whenever possible.

Text: Chemical Process Principles Part I: Hougen and Watson. Industrial Stoichiometry Lewis and Radasch. Chemical Engineers Handbook; Perry

Prerequisites: Ch-101(C) or Ch-121(B).

Ch-800(A) CHEMISTRY SEMINAR 2-0

This course involves library investigations of assigned topics, and reports on articles in the current technical journals.

Prerequisites; None.

Typing and Radio Code	Co-101(C)
Radio Code and Procedure	Co-102(C)
Visual and Voice Procedure	Co-103(C)
Communication and Other Pertinent Naval Organizations	Co-104(C)
Communication Procedure	Co-110(C)
Teletypewriter; Appendices to Com Inst	Co-111(C)
International and Commercial Communications	Co-112(C)
Correspondence and Mail	Co-113(C)
Crypto Systems Instruction	Co-114(C)
Communication Organization and Security	Co-120(C)
Communication Plans (Basic Rapid Comm Plan)	Co-121(C)
Communication Plans (Type and Task Force)	Co-122(C)
Communication Plans (Amphibious and Deceptive)	Co-123(C)
Tactics	Co-131(C)
Tactics	Co-132(C)
Tactics	Co-133(C)
Tactics	Co-134(C)
Tactics	Co-135(C)

Co-101(C) TYPING AND RADIO CODE 0-4

This course is the first in the operating communication series. Students attaining a proficiency of 30 words per minute during the course will then be started on radio code. Students who have not reached 30 WPM (typing) by the end of the term will be examined periodically during later terms until they attain this speed.

Prerequisites: None.

Co-102(C) RADIO CODE AND PROCEDURE 0-4

This is the second course in the operating communication series. It is a continuation of Co-101 and is designed to make the student proficient by actual operation in radio CW procedure, circuit disipline, message drafting, log keeping, message servicing, and handling all types of radio CW messages through the use of simulated drill or fleet circuits.

Prerequisites: Co-101(C).

Co-103(C) VISUAL AND VOICE PROCEDURES 0-3

This course is the third in the operating communication series. It is designed to make the student proficient by actual operation in radio voice procedure, flashing light procedure, and semaphore procedure Transmission of general signals by these methods, which is studied in Co-120, is given practical demonstration both in Co-102 and Co-103 and the tactical practical works

Prerequisites: Co-101(C); Co-102(C).

Co-104(C) COMMUNICATION AND OTHER PERTINENT NAVAL ORGANIZATIONS 2-1

This course is the final one of the operational communication series. It covers the organizational problems of the communication service ashore and afloat and the latest developments. The recitation periods are devoted in part to seminar presentation of the organization and duties of communications organizations and partly to the other phases of naval organization. The practical work periods are used for lectures by competent officers from the field on the various phases of the communication service in which they are currently performing duty.

Prerequisites: None

Co-110(C) COMMUNICATION PROCEDURE 2-2

In this course the student officer learns the principles of effective message drafting. He studies the construction and use of operating Signals, Prosigns, Call Signs, Routing Indicators, and Delivery Groups. He becomes familiar with the format and use of the General Signal Book. He learns the application of the principles and rules learned in various forms of Naval Messages. (Various Navy Publications).

Prerequisites: None.

Co-111(C) TELETYPEWRITER; APPENDICES TO COMINST 2-2

This course covers tape relay procedures and instructions, handling of toll traffic, and other special instructions pertinent to functions of Communication Officers.

Prerequisites: None.

Co-112(C) INTERNATIONAL & COMMERCIAL COMM. 1-1

This course covers International Agreements, Frequencies and Navigational Aids. In addition it covers communications with merchant ships and communications with the Coast Guard. The operation of various commercial companies and their interrelationship with U.S. Naval Communication Service is included.

Prerequisites: None.

Co-113(C) CORRESPONDENCE AND MAIL 1-0

This course consists of lectures and written exercises on office management, files and filing, and correspondence; with a brief summary of the duties of the shipboard Communication Officer with regards to Postal Service.

Prerequisites: None.

Co-114(C) CRYPTO SYSTEMS INSTRUCTION 0-2

The student is taught the actual handling and manipulation of cryptographic aids and devices and is given sample texts to encrypt and decrypt using all effective systems. In addition, the overall crypto plan of the U. S. Navy is studied theough practical works on the subject.

Prerequisites: Co-110(C).

Co-120(C) COMMUNICATION ORGANIZATION AND SECURITY 2-1

In this course the student officer is acquainted with the organization of the Naval Communication System, the reasons for its existence, and the communication policies established including the principles and rules for security and registered publication handling. (Various Navy Publications).

Prerequisites: None.

Co-121(C) COMMUNICATION PLANS (BASIC RAPID COMM. PLAN) 2-1

This is the second of the series of formal study courses covering communication subjects. It is based primarily on the study of the basic rapid communication plan. The practical works consist of correlating exercises involving the interpretation of simple communication plans and the preparation of simple exercise plans.

Prerequisites: Co-110(C); Co-120(C).

Co-122(C) COMMUNICATION PLANS (TYPE AND TASK FORCE) 2-3

This course is a continuation of the formal study of Communication Planning. It covers the application of principles learned to the development of typical communication plans for Surface Action Force, Carrier Task Force, Escort of Convoy, and Submarine Force Operations. The practical work covers the interpretation of typical COMPLANS and the preparation of exercise plans.

Prerequisites: Co-110(C); Co-120(C); Co-121(C)

Co-123(C) COMMUNICATION PLANS - AMPHIBIOUS AND DECEPTIVE 1-3

This course is the final formal study of communication planning. It covers the application of principles learned to the development of typical communication plans for Amphibious and Deceptive Operations. The Practical work covers the interpretation of COMPLANS and the preparation of exercise Plans. The completion of this course realizes the objective of furnishing the student with background knowledge required to draw up or assist in drawing up a communication plan suitable to any mission assigned or derived.

Prerequisites: Co-121(C); and Co-122(C).

Co-131(C) TACTICS 2-2

By formal study of the Principles and Applications of Naval Warfare, General Tactical Instructions, and CIC Instructions, the student is prepared for the study in later terms of the procedures developed to solve the tactical problems of specific forces. The practical works emphasized the usefulness of the maneuvering board and CIC in the solution of such problems. They also point up the relation of Communications to operations, and demonstrate the intimate relationship of general signals with tactics.

Prerequisites: None.

Co-132(C) TACTICS 2-2

By study of Surface Action and Tactics and the Carrier Task Force Tactical Instructions the student officer learns how the principles studied in the first term are applied to the operations of the Striking Forces. By study of the Long Range Air Reconnaisance and Scouting Instructions and the Logistic Support Force Instructions he learns of the support required for large scale operations. Practical works emphasize the magnitude of tactical problems encountered by Striking Force commanders and introduce the element of timing in operations.

Prerequisites. Co-131(C).

Co-133-(C) TACTICS 2-2

This course introduces the student officer to the tactical problems involved in Amphibious Operations and outlines the procedures developed to solve these problems.

Prerequisites: Co-132(C)

This course introduces the student officer to the tactical problems of Submarine, Anti-Submarine, and Convoy Escort Commanders, and outlines the procedures developed to solve these problems.

Prerrquisites: Co-133(C).

Co-135(C) Tactics

The student officer is required to complete four assignments of the U.S. Naval War College Correspondence Course in Strategy and Tactics prior to the completion of his instruction at the Postgraduate School.

CRYSTALLOGRAPHY

Cr Courses

Crystallography and X-Ray Techniques	Cr-271(B)
Crystallography and Mineralogy	Cr-301(B)

Cr-271(B) CRYSTALLOGRAPHY AND X-RAY TECHNIQUES 3-2

This course is desgined for the student in metallurgy, chemistry, physics and allied fields to supply the requisite background for courses which embody such concepts as the physics of the solid state, for example, the physics of metals optical and x-ray identification of chemical compounds such as explosive mixtures and studies concerning crystal structures in general

The student is first introduced to the fundamental concepts of crystallography including symmetry point groups plane lattices space lattices space groups coordinate systems indices crystal classes crystal systems, common forms and combinations in the various systems The stereographic projection is then studied

With this foundation some time is spent on a discussion of the crystal structure of the elements metals alloys and inorganic compounds

The latter part of the course is devoted to acquainting the student with modern x-ray diffraction and radiographic apparatus and techniques including the theory of x-ray diffraction the Bragg equation powder methods, single crystal and moving film methods high temperature diffraction technique as applied to obtaining phase diagrams back reflection and transmitted beam methods and practical applications of these methods

The laboratory work includes a study of crystal models for symmetry, forms and combinations the construction of stereographic projections and actual practice in the making and interpreting of x-ray diffraction photographs

Texts Mineralogy Dana Ford Structure of Metals Barrett

Prerequisites Ch 101(C)

Cr-301(B) CRYSTALLOGRAPHY AND MINERALOGY 3-4

This course is designed primarily for the student who will continue with courses in mineralogy geology and petrology

The student is first introduced to the fundamental concepts of crystallography including Symmetry point groups plane lattices space lattices; space groups coordinate systems indices, crystal classes, crystal systems; common forms and combinations in the various systems and classes The stererographic projection is then studied with special reference to its application to crystallographic problems The theory of x-ray diffraction and the application of x ray powder methods is taken up as applied to identification of minerals

The remainder of the time is spent on the description of some fifty of the more common minerals

The laboratory work includes a study of crystal models for symmetry forms and combinations the practical application and construction of stereographic projections determination of minerals by x-ray powder diffraction patterns and as time permits a start is made in the identification of minerals

Text Textbook of Mineralogy, Dana Ford

Prerequisite Ch 101(C)

EE Courses

Fundamentals of Electrical Engineering	EE-111(C)
DC Circuits and Fields	EE-151(C)
Electric Circuits and Fields	EE-171(C)
DC Machines and AC Circuits	EE-231(C)
AC Circuits	EE-251(C)
AC Circuits	EE-271(C)
AC Circuits	EE-272(C)
AC and DC Machinery	EE-314(C)
DC Machinery	EE-351(C)
Special Machines	EE-355(C)
DC Machinery	EE-371(C)
Transformers and Synchros	EE-451(C)
Polyphase Transformers, Synchronous Machine and Induction Motors	EE-452(C)
Asynchronous Motors	EE-455(C)
Transformers, Asynchronous Machines, and Synchros	EE-471(C)
Synchronous Machines	EE-472(C)
Synchros	EE-473(B)
Transmission Lines and Filters	EE-551(B)
Transmission Lines and Filters	EE-571(B)
ServoMechanisms	EE-611(B)
Transients and Servos	EE-651(B)
Filters and Transients	EE-655(B)
Transients	EE-671(A)

EE Courses

Servomechanisms	EE-672(A)
Electronics	EE-711(C)
Power Electronics	EE-731(C)
Electronics	EE-751(C)
Electronics	EE-753(C)
Electronic Control and Measurement	EE-755(A)
Electronics	EE-771(B)
Electronics	EE-772(B)
Electrical Machine Design	EE-871(A)
Electrical Machine Design	EE-872(A)
Electrical Machine Design	EE-873(A)
Seminar	EE-971(A)
Seminar	EE-972(A)

EE-111(C) FUNDAMENTALS OF ELECTRICAL ENGINEERING 3-2

This course presents a basic treatment of the general theory of electric and magnetic circuits. Electrical units, Ohm's Law, and Kirchoff's laws are studied in detail. The magnetic field and the magnetic properties of iron and steel are included.

Texts: Electrical Engineering Vol. I; Dawes

Prerequisites: None.

EE-151(C) DC CIRCUITS AND FIELDS 3-4

This course provides a thorough foundation in electricity and magnetism with the major emphasis on electric and magnetic circuits. The basic laws are given and many problems and laboratory experiments are assigned to illustrate the theory. The course serves as a preparation for further study in electrical engineering.

Texts: Basic Electrical Engineering Corcoran.

Prerequisites: None.

EE-171(C) ELECTRIC CIRCUITS AND FIELDS 3-4

This course provides a very thorough foundation in electricity and magnetism for a curriculum majoring in electrical science. The basic laws are given in detail. Many problems are assigned and laboratory experiments are performed to illustrate the classroom theory. The course serves as a foundation for further advanced study.

Texts. Basic Electrical Engineering; Corcoran.

Prerequisites: None

EE-231(C) DC MACHINES AND AC CIRCUITS 3-2

This course presents the general principles of DC machines, both motors and generators, and of their control and application. The qualitative characteristics of the various machines are developed from basic principles. Then a study of the theory of alternating currents is begun. Experiments are performed to demonstrate the general machine characteristics and the use of control devices.

Texts: Electrical Engineering, Volumes I and II. Dawes.

Prerequisites: EE-11(C)

EE-251(C) ALTERNATING CURRENT CIRCUITS 3-4

This course presents the essential theory for those curricula that do not require an extensive coverage It consists of an elementary presentation of single-phase series and parallel circuits resonance vector representation and vector algebra the most commonly used network theorems, non-sinusoidal wave analysis coupled circuits and balanced polyphase circuits. Laboratory and problem work illustrate the basic theory

Texts: AC Circuits Kirchner and Corcoran

Prerrquisites EE-151(C)

EE-271(C) ALTERNATING CURRENT CIRCUITS 3-2

This course and EE-272 which follows present in a thorough way the basic theory of the alternating current circuit for those curricula that require an extensive coverage. The theory is developed from fundamental physical principles The course covers single-phase series and parallel circuits, resonance vector algebra and vector representation of electrical magnitudes network theorema, non-sinusoidal wave alanysis, balanced polyphase circuits and power measurements in polyphase circuits. Many problems and laboratory work illustrate the basic theory

Text AC Circuits Kirchner and Corcoran.

Prerrquisites EE 171(C)

EE-272(C) ALTERNATING CURRENT CIRCUITS 2-2

This course is a continuation of EE 271 It completes the basic theory of the alternating current circuit for those curricula requiring a thorough preparation for further advanced study The course includes unbalanced polyphase circuits instruments and measurements coupled circuits bridge theory and symmetrical components Many problems and laboratory work illustrate the basic principles

Text AC Circuits Kerchner and Corcoran

Prerequisites: EE-271(C)

EE-314(C) DC AND AC MACHINERY 3-4

This course presents a brief treatment of electrical machines for those curricula that do not require advanced work in electrical engineering It consists of an elementary study of DC machines and their characteristics, the alternator the synchronous motor and the induction motor Laboratory and problem work illustrate the principles

Texts Electrical Engineering Volumes I and II Dawes

Prerequisites: EE-

EE-351(C) DC MACHINERY 2-2

This course presents the fundamentals of direct current machinery with emphasis upon operating characteristics and applications The external characteristics are developed from basic relations Problems are assigned and laboratory work supplements that of the classroom

Text: Direct Current Machinery Pender

Prerequisites: EE-151(C) or EE-171(C)

EE-355(C) SPECIAL MACHINES 2-0

This course presents the theory of the amplidyne-motor, rototrol-motor, generator-motor, and motors operated under the conditions of variable voltage and current supply. Emphasis is placed upon the transfer function (ratio of torque output to voltage input) necessary as a preparation for work in servo-mechanisms.

Text: Lecture Notes

Prerequisites: EE-151(C).

EE-371(C) DC MACHINERY 3-2

Thie course gives a thorough presentation of the theory and performance of direct current machines and control devices Armature windings, armature reaction, and commutation are fully covered. The operating characteristics of generators and motors are developed from basic relations so as to provide a foundation for subsequent work in design. Problems are assigned to illustrate the application fo the theory. Laboratory work supplements the work of the classroom.

Text: Principles of DC Machines, Langsdorf.

Prerequisites: EE-171(C).

EE-451(C) TRANSFORMERS AND SYNCHROS 2-2

This course gives a general treatment of transformers and synchros for the curricula that do not require an extensive treatment. It covers single-phase transformer principles and operating characteristics including the auto-transformer, constant current transformer, and special transformers. Also, polyphase transformer connections and the polyphase transformer are covered. Single phase and polyphase synchro construction features, operating characteristics, and basic theory are included A comprehensive analysis is included of the voltage, current, and torque relations for regular and fault synchro conditions. Laboratory and problem work illustrate the theory of the classroom.

Text: Fundamentals of A. C. Machines, Sah.

Prerequisites: EE-251(C).

EE-452(C) SYNCHRONOUS MACHINES AND INDUCTION MOTORS 3-4

This course is a continuation of EE-451(C). It completes a general presentation of AC machinery for those curricula that do not require an extensive treatment. Alternators, synchronous motors, polyphase and single-phase induction motors are presented. A brief survey of induction generators, induction regulators, and the commutor type AC motor is included. Laboratory and problem work illustrate the bssic theory.

Text: Fundamentals of A C. Machines, Sah.

Prerequisites: EE-451(C).

EE-455(C) ASYNCHRONOUS MOTORS 2-2

This course gives an elementary presentation of the principles and operating characteristics of the induction motor and of single-phase commutator motors. Emphasis is placed upon the unbalanced operation of the two-phase symmetrical induction motor. Laboratory and problem work supplement the theory.

Text: Fundamentals of A C. Machines, Sah.

Prerequisites: EE-451(C).

EE-471(C) TRANSFORMERS, ASYNCHRONOUS MACHINES, AND SYNCHROS 3-4

This course gives a thorough presentation of the principles and operating characteristics of transformers, asynchronous machines, and synchros for the curricula requiring advanced electrical engineering work leading to design. In detail the basic theory of single-phase and polyphase transformers, including auto transformers, constant current, and special transformers is presented. Polyphase induction motor principles, including armature windings, voltage and mmf waves, and operating characteristics are emphasized. Induction generators, single-phase induction motors, and the commutator type AC motor are included. Synchro theory with an analysis of the voltage, current, and torque relations for normal and fault conditions is presented. Laboratory and problem work supplement the basic theory.

Text: AC Machinery, Bryant and Johnson.

Prerequisites: EE-272(C).

EE-472(C) SYNCHRONOUS MACHINES 3-4

This course is a continuation of EE-471. Alternator and synchronous motor characteristics are presented on the basis of cylindrical motor and two reaction theories. Armature winding, voltage and mmf waves, armature reaction, load saturation curves, regulation, and losses are emphasized. Parrallel operation, frequency changers, and synchronous converters are presented. Many problems and laboratory work supplement the basic theory.

Text: AC Machinery, Bryant and Johnson.

Prerequisites: EE-471(C).

EE-473(B) SYNCHROS 2-2

This course presents a thorough treatment of the basic theory of synchros and synchros systems for curricula requiring preparation for further advanced study. The mathematical analysis of single phase and ploy phase synchro systems covers voltage, current, and torque relations for normal and fault conditions, vector diagrams, and equivalent circuits. Problems and laboratory work supplement the theory. The course is presented in lecture form.

No suitable text is available.

Prerequisites: EE-272(C).

EE-551(B) TRANSMISSION LINES AND FILTERS 3-2

This course presents the essential basic principles of transmission lines and filters. The topics covered are transmission line parameters, infinite line, open and shorted lines, reflection, matching, stubs, T and Pi sections, constant K and M derived sections, and composite filters. Problems and laboratory work are included.

Text: Communication Circuits, Ware and Reed.

Prerequisites: EE-251(C).

EE-571(B) TRANSMISSIIN LINES AND FILTERS 3-4

This course presents a thorough coverage of the basic theory of transmission lines and filters for the curricula requiring preparation for further advanced work. The topics covered in detail are transmission line parameters, infinite line, open and shorted lines, reflection, transmission line efficiency, impedance transformation, stubs, T and Pi sections, constant K and M derived sections, and composite filters. Problems and laboratory work supplement the theory.

Text: Communication Circuits, Ware and Reed.

EE-611(B) SERVOMECHANISMS 3-4

This course presents the essential basic principles of servo-mechanisms. The topics covered are the amplidyne, the elements of electrical transients, the synchro, and an introduction to servo-mechanism devices. Problems and laboratory work supplement the classroom theory.

Text: Introduction to Electric Transients, Kurtz and Corcoran.

Prerequisites: EE-314(C).

EE-651(B) TRANSIENTS AND SERVOS 3-4

This course presents the essential basic principles of electrical transients and servo-mechanisms. The topics covered are DC and AC transients in series, parallel, series-parallel, and coupled circuits using the methods of differential equations and Heaviside. The La Place transform method is introduced. An analysis is given of servo-mechanisms with viscous damping and differential and integral control, using the transfer function method. Problems and laboratory experiments illustrate the theory.

Texts: Transients in Linear Systems, Gardner and Barnes: Servomechanism Fundamentals, Lauer, Lesnick and Matson

Prerequisites: EE-451(C).

EE-655(B) FILTERS AND TRANSIENTS 3-2

This course presents the essential basic principles of filters and electrical transients. For filters the topics are T and Pi sections and composite filters. In transients the topics include DC and AC transients in series, parallel, series-parallel, and coupled circuits, using the methods of differential equations and Heaviside. The La Place transform method is introduced. Problems are assigned.

Texts: A.C. Circuits, Kerchner and Corcoran; Introduction to Electric Transients, Kurtz and Corcoran.

Prerequisites: EE-251(C).

EE-671(A) TRANSIENTS 3-4

This course presents in a very thorough way the basic theory of electrical transients in networks for the curricula requiring preparation for further advanced study. The topics covered are DC and AC transients in series, paeallel, series parallel, and coupled circuits for particular boundary conditions using the methods of differential equations. Heaviside Fourier, and La Place. Non-linear constants the forcing functions other than DC and AC are included. Many problems illustrate the basic theory and the methods of analysis.

Texts: Transients in Linear Systems, Gardner and Barnes: Introduction to Electric Transients, Kurtz and Corcoran.

Prerequisites: EE-251(C) or EE-272(C).

EE-672(A) SERVOMECHANSIMS 3-4

This course presents a thorough treatment of the basic theory of servomechanisms for curricula requiring further advanced study. In this course the topics covered are elementary forms of control systems, servo system follow-up links, analysis of servo-mechanisms with viscous damping, error rate damping, integral control, transfer function and db-log frequency analysis methods, error rate stabilization networks, typical design calculations, and general considerations. Problems and laboratory work illustrate the theory and the methods of analysis.

Text: Principles of Servomechanisms, Brown and Campbell

Prerequisites: EE-671(A); EE-452(C) or EE-473(B).

EE-711(C) ELECTRONICS 3-2

This course treats of the fundamental theory of the electron, gaseous conduction, therionic emission, and electron tube characteristics The principles of the ampliflier, rectifier, and oscillator circuits are presented in their essentials. Some consideration is given to the special tubes encountered in electronic devices. Laboratory work serves to integrate the principles presented in the classroom with practical applications and circuits.

Text: Engineering Electronics, Fink.

Prerequisites: None.

EE-731(C) POWER ELECTRONICS 3-2

This course presents the theory of electronics and synchro instruments, and a study of their applications to naval devices. The theory and applications of the various types of electron tubes is covered Emphasis is placed upon the thyratron tube. Also the theory of the selsyn instrument and its use is included. The laboratory work consists of experiments that demonstrate the characteristics and applications of tubes and selsyns. Remote conttol is illustrated with laboratory models.

Text: Electronic Engineering Principles Ryder

Prerequisites. EE-231(C).

EE-751(C) ELECTRONICS 3-4

This course treats of electron tube characteristics and the basic circuits in which tubes are used. The theory and application of vacuum tubes and gas tubes are covered including such special tubes as the ignitron, cathode ray tube, and phototube. The basic theory of rectifier and amplifier circuits is developed and illustrated in actual commercial applications. Problems and laboratory work are designed to supplement the classroom presentation.

Text: Electronic Engineering Principles, Ryder.

Prerequisites: EE-451(C)

EE-753(C) ELECTRONICS 1-2

This course presents an analysis of electronic control circuits. The use of vacuum and gas-filled tubes in the control of motors, generators, and mechanical devices is well covered. Laboratory work supplements the theory.

Text: None.

Prerequisites EE-451(C).

EE-755(A) ELECTRONIC CONTROL AND MEASUREMENT 3-4

This course presents the principles and practice of electronic control and measurement as used in reasearch laboratories and in industry. It includes the theory of basic circuits such as vacuum tube voltneters, bridges, direct coupled amplifiers, timing circuits and frequency sensitive circuits with particular attention to their application in industrial instruments for the measurement and control of current, voltage, frequency, illuminators, speed, pressure, and temperature.

Texts: The Electronic Control Handbook, Batcher and Moulic: Applied Electronics MIT. staff.

Prerequisites. EE-751(C).

EE-771(B) ELECTRONICS 3-2

This course consists of a thorough presentation of the theory of electron tubes and circuits in which they are used for those curricula requiring preparation for further advanced work. It includes the theory of electron motion in electric or magnetic fields, vacuum and gas tube characteristics, and the principles of special tubes such as the ignitron, glow tube, cathode ray tube, and phototube. Circuit theory of rectifiers, detectors, amplifiers, and oscillators is covered with particular attention to industrial power and control applications. Laboratory experiments and problems supplement the basic theory.

Text: Applied Electronics, M.I.T. staff.

Prerequisites: EE-273(C).

EE-772(B) ELECTRONICS 3-2

This course is a continuation of EE-771(B). It presents in detail the more complicated electronic circuits encountered in practice with particular attention to the integration of various components in accordance with basic theory of stabilization and feedback.

Text: Applied Electronics, M.I.T. staff.

Prerequisites: EE-771(B).

EE-871(A) ELECTRICAL MACHINE DESIGN 4-0

This course presents a thorough quantitative analysis of machine characteristics using the design approach. It serves to develop an appreciation for the limitations and possibilities in electrical machine construction especially for naval applications, and the ability to evaluate properly the merits of present designs. In particular, this course consists of the quantitative study and design of a transformer to meet certain specifications. Later, the analysis of the DC machine is begun.

Text: Principles underlying the Design of Electrical Machinery, Slichter.

Prerequisites: EE-472(C).

EE-872(A) ELECTRICAL MACHINE DESIGN 4-0

This course is a continuatuio of EE-871(A). It consists of the completion of the quantitative analysis and design of a DC machine and the beginning of a similar analysis of the synchronous machine.

Text: Principles Underlying the Design of Electrical Machinery, Slichter.

Prerequisites: EE-871(A).

EE-873(A) ELECTRICAL MACHINE DESIGN 4-0

This course is a continuation of EE-872(A). It consists of the completion of the quantitative analysis and design of a synchronous machine and a similar analysis and design of the induction machine.

Text; Principles Underlying the Design of Electrical Machinery, Slichter.

Prerequisites: EE-872(A).

EE-971(A) SEMINAR 1-0

In the seminar sessions papers on research and developments in the field of electrical science are presented to the more advanced groups of students. Some appreciation for research methods is developed. In these sessions papers treating of research in progress and matters of major importance in electrical engineering are delivered by the faculty and by the students pursuing an advanced engineering curriculum.

Prerequisites: A background of advanced work in electrical engineering.

EE-972(A) THESIS

This work provides an opportunity for research and study necessary for the preparation of the thesis as required for the Master's Degree in Electrical Engineering. Individual laboratory and library work is performed under the general supervision of the members of the electrical engineering staff.

Prerequisites: The first two years of the advanced electrical engineering curriculum.

Es Courses

Electronics Administration	Es-036(C)
Electricity	Es-111(C)
Electricity	Es-112(C)
Circuit Analysis and Measurement	Es-113(C)
Circuit Analysis and Measurement	Es-114(C)
Advanced Circuit Theory	Es-121(A)
Advanced Circuit Theory	Es-122(A)
Radio Frequency Measurements	Es-126(C)
Advanced Circuit Theory	Es-133(A)
Advanced Circuit Theory	Es-134(A)
Communications Fundamentals	Es-186(C)
Electron Tubes	Es-211(C)
Electron Tubes	Es-212(C)
Electron Tubes	Es-213(C)
Electron Tubes	Es-214(C)
Electron Tubes	Es-225(A)
Ultra-High Frequency Tubes	Es-226(A)
Introduction to Radar Applications of Vacuum Tubes	Es-256(C)
Electron Tubes and Circuits	Es-261(C)
Electton Tubes and Circuits	Es-261(C)
Electronic Fundamentals	Es-281(C)
Vacuum Tube Circuits	Es-282(C)
Vacuum Tube Circuits	Es-283(C)
Pulsing and High-Frequency Circuits	Es-286(C)
Radio Systems	Es-321(B)
Radio Systems	Es-322(B)
Radio Systems	Es-333(B)
Transmitters and Receivers	Es-386(C)

Radar	Es-431(B)
Radar Systems	Es-432(B)
Introduction to Radar	Es-446(C)
Introduction to Radar (Airborne)	Es-456(C)
Special Systems	Es-531(B)
Special Systems	Es-532(B)
Special Systems	Es-586(C)
Electromagnetics	Es-621(A)
Electromagnetics	Es-622(A)
Electromagnetics	Es-623(A)
Electromagnetics	Es-624(A)
Antennas, Transmission Lines, and Wave Guidee	Es-736(B)
R.F. Energy Transmission	Es-786(C)
Thesis	Es-831(A)
Thesis	Es-832(A)
Project Seminar	Es-836(A)
Introduction to Electronics	Es-991(C)
Introduction to Electronics	Es-992(C)

ES-036(C) ELECTRONICS ADMINISTRATION 2-0

A problem and lecture series designed to acquaint the student with the administration and organization of electronics activities and applications, ashore and afloat. Army, Navy and Air Force organization; Shipyard electronics organization; radio station administration electronics supply matters are among the topics covered.

Prerequisites: None.

Es-111(C) D.C. ELECTRICITY 4-4

This course is laid out to develop a sound conception of electromotive force, potential, resistance, current, a facillty in the use of such basic principles as Ohm's law Kirchhoff's laws, series, parallel, and series-parallel circuits, the theory and use of D-C instruments and bridges, the magnetic circuit, and a simple treatment of D-C transients in RL and RC circuits.

The laboratory is designed, by the inclusion of simple experiments to make clear the fundamental concepts studied in class. One of its primary aims is to acquaint the students with typical circuit components and basic measuring devices and their proper use.

Text: Fundamentals of Electrical Engineering, Hessler & Carey.

Es-112(C) A.C. ELECTRICITY 4-3

Continuation of Es-111(C). Alternating current principles are introduced; sound conceptions of steady state circuit analysis are developed; reactance, impedance, admittance, conductance susceptance, network theorems, series and parallel circuits, complex notation, non-sinusoidal waves, resonant circuits, and elementary three phase circuit theory

Laboratory exercises illustrate principles and introduce measurement instruments.

Text: Alternating Current Circuit Theory, Reed.

Prerequisites: Es-111(C).

Es-113(C) CIRCUIT ANALYSIS & MEASUREMENTS 3-3

Continuation of Es-112(C). This course is designed to develop the fundamentals and to provide drill in elementary radio circuit analysis. In addition the student is introduced to the techniques of measurements at radio frequencies. The topics included are: coupled circuits, network theorems, the infinite line, radio frequency bridges, measurements involving complex wave forms in high impedance, high frequency circuits.

Texts: Communication Engineering, Everitt: Radio Engineering, Terman: Measurements in Radio Engineering, Terman

Prerequisites Es-112(C)

Es-114(C) CIRCUIT ANALYSIS & MEASUREMENTS 3-3

Continuation of Es-113(C). The topics included are: reflections in lines, the solution of the general line stubs, derivation and use of circle diagrams, constant K and M-defived filters, impedance transformations, the use of slotted lines in impedance measurements.

Prerequisites: Es-113(C).

Es-121)A) ADVANCED CIRCUIT THEORY 3-2

Introduction to transient phenomena in electrical networks and their solutions on the loop and nodal basis; modes. Solutions are by classical methods, fourier Integral, LaPlace transforms.

Texts: Communication Networks, Vol. I; Guillemin: Frequency Analysis, Modulation, and Noise; Goldman: Transients in Linear Systems; Gardner and Barnes.

Prerequisites: Es-114(C).

Es-122(A) ADVANCED CIRCUIT THEORY 3-2

Continuation of Es-121(A). The LaPlace transform is employed for solution of transients in typical circuits used in radio and radar.

Text: Transients in Linear Systems; Gardner and Barnes.

Prerequisites: Es-121(A).

Es-126(C) RADIO FREQUENCY MEASUREMENTS 2-6

This course is designed to study the techniques of the measurement of voltage, current, power, impedance and frequency bridges in the various frequency ranges. The topics include a detailed study of radio frequency, resonant methods, precision slotted lines, microwave measurements,, standards of E.R.L.C. and F.

Text! Radio Frequency Measurements, Hartshorn.

Prerequisites: Es-114(C), Es-225(A).

Es-133(A) ADVANCED CIRCUIT THEORY 3-0

Continuation of Es-122(A). The transmission line as a communication facility leading to filter theory is treated. Particular topics are, Four terminal Networks, Foster's reactance theorem with Cauer's extension, Lagrange's equations, driving point impedance, principle of duality, lumped loaded lines, lattice structures.

Text: Communication Networks, Vol. II, Guillemin.

Prerequisites: Es-122(A).

Es-134(ADVANCED CIRCUIT THEORY 3-0

Continuation of Es-133(A). The theory and basic design of ladder and lattice structure filters are studied together with their transient behavior.

Texts: Communication Networks, Vol. II; Guillemin: Network Analysis and Feedback Amplifiers; Bode.

Prerequisites: Es-133(A).

Ea-186(C) COMMUNICATIONS FUNDAMENTALS 4-4

Course contents cover the fundamental principles of radio communications and basic circuits. Included topics are: Fundamentals of energy transmission by means of radio waves; basic alternating current theory; frequency selectivity circuits; coupled circuits.

Text: Radio Engineering Terman

Es-211(C) ELECTRON TUBES AND CIRCUITS 2-3

This course gives an elementary treatment of thermionic emmission, space charge, diodes, triodes, tetrodes, pentodes, cathode-ray tubes, oscilloscope, gas tubes, thyratrous, rectifiers, power filters and regulated powet supplies.

Texts: Electronic Circuits and Tubes; Cruft: Electron-tube circuits; Seely: Radio Engineering; Terman

Prerequisites: None.

Es-212(C) ELECTRON TUBES AND CIRCUITS 2-3

Continuation of Es-211(C). Thms course emphasizes the use of the vacuum tube as a switch. Topics are timing, sweep and pulse circuits; audio voltage amplifier, square-wave generator, clippers, clampers, differentiators, integrators, switching, keying, trigger circuits, multivibrators, and oscilloscope circuits.

Texts: Electronic Circuits and Tubes; Cruft: Electron-tube Circuits; Seely: Radio Engineering; Terman

Prerequisites: Es-211(C)

Es-213(C) ELECTRON TUBES AND CIRCUITS 2-3

Continuation of Es-212(C). This course covers power amplifiers, video and transformer-coupled voltage amplifiers, phase inverters, cathode follower, inverse feedback, R-F, I-F, and wide-band tuned amplifiers, feedback oscillators.

Texts: Electronic Circuits and Tubes; Cruft: Radio Engineering; Terman: Electron-tube Circuits; Seely.

Prerequisites. Es-212(C)

Es-214(c) ELECTRON TUBES AND CIRCUITS 4-3

Continuation of Es-213(C) covering oscillators, B-F, R-C, and relaxation oscillators, A-M, F-M, and P-M methods of modulation, diode, square-law, grid and plate detection; AVC, infinite impedance detector, discriminators; receiver principles; polyphase and controlled rectifiers; theory of electrons in metals, emission, semi-conductors, etc.

Texts: Electronic Circuits and Tubes; Cruft: Electron-tube Circuits; Seely: Radio Engineering; Terman

Prerequisites: Es-213(C)

Es-225(A) ELECTRON TUBES 3-6

Continuation of Es-214(C). Noise, electron ballistics, electron optics, cathode-ray tubes, photomultiplier tubes, television tubes; limitations of conventional tubes at ultra.high frequency and transit time effects.

Text: Vacuum Tubes; Spangenberg.

Prerequisites: Es-214(C).

Es-226(A) ULTRA-HIGH-FREQUENCY TUBES 4-3

Cavity resonators, klystron and magnetron tubes and circuits, traveling-wave tubes, pulsing circuits, and related laboratory work.

Text: Vacuum Tubes; Spangenberg: Radar System Engineering; Ridenour: Principles of Radar; MIT.

Prereq isites: Es-225(A), Es-623(A).

Es-256(C) INTRODUCTION TO RADAR APPLICATIONS OF VACUUM TUBES 2-0

The use of a tube as a switch. Clipping device, Multivibtators, Sawtooth Generators, Simple R-C Transient Circuits.

Text: Radar Electronic Fundamentals; Navships 900,016.

Prerequisites: None.

Es-261(C) ELECTRON TUBES AND CIRCUITS 3-2

The first term of a two-term course in the fundamentals and general applications of electron tubes and circuits, primarily for non-communication students, Includes emmission, characteristics of vacuum and gas tubes, rectifiers and filters, grid-controlled rectifiers, class A amplifiers.

Text: Applied Electronics; M.I.T.

Prerequisites: Es-111(C), Es-112(C).

Es-262(C) ELECTRON TUBES AND CIRCUITS 3-2

Continuation of Es-261(C). Includes feedback amplifiers, class B and C amplifiers, oscillators, modulation and detection.

Text: Apppied Electronics, M.I.T.

Prerequisites: Es-261(C).

Es-281(C) ELECTRONIC FUNDAMENTALS 2-2

Course contents cover the basic principles of electronics. Included topics are: Review of basic mathematical concepts; The underlying physical principles of electron tube operation; Characteristics of electron tube operation.

Text: Physics; Robeson; Fundamentals of Vacuum Tubes; Eastman; Mathematics for Electricians & Radiomen; Cooke.

Prerequisites: None.

Es-282(C) VACUUM TUBE CIRCUITS 4-4

Continuation of Es-281(C). Course contents cover the operational characteristics of electron tubes and some of their applications. Included topics are: general operational features of diodes, triodes, multigrid tubes and gas tubes; amplification of small alternating voltages; power amplifiers.

Text: Fundamentals of Vacuum Tubes; Eastman: Radio Engineering; Terman:

Prerequisites: Es-281(C).

Es-282(C)VACUUM TUBE CIRCUITS 4-3

Continuation of Es-282(C). Course contents cover further applications of electron tubes, in continuation of the course material presented in Es-282(C) Included topics are: Sine wave oscillators; Amplitude modulation and the A-M transmitter; Demodulation and the TRF receiver; Frequency translation and the superheterodyne A-M receiver; power supplies; Frequency modulation.

Text: Fundamentals of Vacuum Tubes; Eastmen: Radio Engineering, Terman

Prerequisites: Es-282(C).

Es-286 PULSING AND HIGH-FREQUENCY CIRCUITS 3-2

Course contents cover the principles and underlying problems of pulsing and high-frequency circuit operation. Included topics are: Characteristics of nonsimusoidal waves; Pulse-shaping techniques; The sawtooth generator, multivibrator, and blocking oscillator; Problems and techniques of high-frequency circuit operation; the magnetron and velocity-modulated tubes, Guided Waves

Text: Radar Electronic Fundamentals; Navships 900,016: Principles of Radar; M.I T. staff.

Prerequisites: Es-282(C).

Es-321(B) RADIO SYSTEMS 3-3

This course is the first of a sequence of five on the engineering applications of theorectical electronics to the specific problems of radio communications and electronic systems aimed to give the student experience in design and to integrate his previous theorectical training as applied in radio systems engineering.

Included is a general survey of the basic problems of a communications system with emphasis on the design of transmitters for medium and high frequencies.

Text: Radio Engineer's Handbook, Terman; War Department Technical Manual, TM11-486 (Electrical Communication System Engineering); Navy Equipment Instruction Books.

Prerequisites: Es-225(A).

Es-322(B) RADIO SYSTEMS 3-3

This is a continuation of the series begun in Es-321(B). Emphasis is placed upon the design of receivers for the reception of amplitude modulated signals in the medium and high frequency bands. The design problem is extended to include the VHF region and the changes introduced by the use of frequency and phase modulation.

Text: Radio Receiver Design, Sturley; Radio Engineer's Handbook, Terman; Microwave Receivers, MIT RadLab; and other selected references.

Prerequisities: Es-321(B).

Es-333(B) RADIO SYSTEMS 3-3

This course continues the systems series. Included are the application of teletype and frequency shift-keying to radio transmission, tone multiplex, applications of multiplexing to remote control, single side-band transmission theory and basic single side-band multiplex transmitter and receiver design.

Text: Naval Instruction Books; Instructor's Notes.

Prerequisities: Es-322(B)

Es-386(C) TRANSMITTERS AND RECEIVERS 3-3

Course contents cover the operational characteristics of typical Navy type transmitters and receivers. Included topics are Frequency standards and meters; Navy transmitters; Navy receivers.

Text: Lecture Notes & Equipment Instruction Books

Prerequisities: Es-283(C), Es-786(C).

Es-431(B) RADAR SYSTEM ENGINEERING 3-3

Fundamental principles of radar. Theory of operation and design features of radar timing circuits, indicators, modulators, transmitters, RF systems and receivers Related laboratory work given concurrently.

Text: Radar System Engineering and M.I.T.; Ridenour; Principles of Radar, Radar School Staff.

Prerequisities: Es-226(A).

Es-432(B) RADAR SYSTEM ENGINEERING 3-6

Continuation of Es-431(B) Study of representative search, firecontrol and IFF systems, including airborne, with particular attention to design features Study of current radar developments, Related laboratory work on current Navy radar equipment.

Text: Radar System Engineering; Ridenour.

Prerequisities: Es-431(B)

Es-446(C) INTRODUCTION TO RADAR 2-2

A study of the radar range equation, i.e. Effect of pulse duration, pulse repetition frequency, Types of targets, etc. Block diagram studies of current fire-control systems, with emphasis on operational limitations, propagation phenomena, types of presentation, and antijam techniques. Laboratory work to emphesize operational techniques of current fire-control systems.

Text: Principles of Radar, M.I.T. Radar School Staff.

Prerequisite: None

Es-456(C) INTRODUCTION TO RADAR (AIRBORNE) 2-2

A study of the radar range equation, i.e. Effect of pulse duration, pulse repetition frequency, types of targets, etc. Block diagram studies of current Airborne systems with emphasis on operational limitations, propagation phenomena, types of presentation, and anti-jam techniques Laboratory on current airborne radar equipment.

Text: Principles of Radar; M.I.T. Radar School Staff.

Prerequisite: None

Es-531(B) SPECIAL SYSTEMS 3-3

A continuation of the series starting with Es-321(B). Pulse modulation principles, pulse time modulation multiples, principles of television, television receiver and transmitter design, facsimile, and basic telemetering systems.

Text: Naval Instruction Books, Instructor's Notes.

Prerequisites: Es-333(B)

Es-532(B) SPECIAL SYSTEMS 3-3

A continuation of the special systems series. Principles of radio direction finding and navigation, and radio and radar countermeasures.

Text: Very High Frequency Techniques, Vol. I; Loran, MIT RadLab; and othdr selected references

Prerequisites: Es-531(B)

Es-586(C) SPECIAL SYSTEMS 3-3

Course contents cover Navy electronic systems other than communications transmitters and receivers. Included topics are: Loran systems; Radar systems; Image transmission systems; Frequency-shift keying techniques; Multiplex Systems.

Text: Lecture Notes and Equipment Instruction Books.

Es-621(A) ELECTROMAGNETICS 3-0

An introduction to the fundamental definitions and circuit parameters later to be used in resonant cavities, wave guides, wave propagation, etc., as exemplified through the differential equations solution of lump circuits and transmission lines. An application of vector analysis to electrostatics and magnetostatics in rectangula and in generalized coordinates, including the gradient, divergence, and curl of electromagnetic fields; scalor and vector potentials; energy stored in electric and in magnetic fields. Text material is considerably amplified in class lectures.

Texts: Fields and Waves in Modern Radio; Ramo and Whinnery.
References: Principles of Electricity and Electromagnetism; Hanwell; Electromagnetic Theory; Stratton; Electromagnetic Waves; Schelkunoff.

Prerequisite: Ma-124.

Es-622(A) ELECTROMAGNETICS 4-0

A continuation of Es-621(A). An application of complex variables to potential theory; derivation of capacitance and inductance per unit length for open wire and co-oxial transmission lines; application of Bessel equations to potential theory; Maxwell's equations; relations between units; Poisson's equations; retarded vector potentials; radiation from current dipole, halfwave antennas; radiation resistance of half-wave antennas in terms of Ci and Si functions; antenna arrays; field patterns and gain of yagi arrays; imput impedance of yagi arrays.

Text: Same as Es-621(A).

Prerequisite: Es-621(A).

Es-623(A) ELECTROMAGNETICS 4-0

A continuation of Es-622(A). Skin effect and internal impedance, solutions involving Bessel and Hankel functions; calculation of inductance. Propagation and reflection of plane electromagnetic waves; attenuation; power factor; waves guided by lossy planes; solutions of Maxwell's equations for rectangular and cylindrical wave guides.

Text: Same as Es-621(A).

Prerequisite: Es-622(A).

Es-624(A) ELECTROMAGNETICS 3-0

A continuation of Es-623(A) Radial disk transmission lines; resonant cavities; generalized Maxwell's equations: generalized method of deriving radiation field patterns; radiation resistance; long straight wire antenna; Vee antenna radiation from end of wave guide; rhombic antenna; non-uniform transmission line; input impedance of antennas.

Text: Same as Es-623(A)
Prerequisite: Es-623(A)

Es-736(B) ANTENNAS, TRANSMISSION LINES 3-3

This course presents the engineering problems associated with the practical design of antennas, antenna systems, and transmission lines. A technique of rapid approximation of antenna field patterns is presented. All of common receiving and transmitting antennas are presented and analyzed. The problems inherent in the various frequency ranges are discussed including the microwave region. The problem of efficient transmission of R.F. energy, matching, phasing and achieving proper current distributions are studied The classwork is accompanied by considerable problem drill and measurements on typical systems.

Prerequisite: Es-624(A)

Es-786(C) R-F ENERGY TRANSMISSION 3-2

Course contents cover the principles and techniques of energy transmission by means of radio-frequency waves. Included topics are: Conditions for maximum energy transfer between circuits; R-F transmission lines for energy transfer; Lines as circuit elements; Principles of energy radiation; Directional-radiation techniques; propagation characteristics; Two hr. P-work periods occasionally used for lecture-demonstrations.

Texts: Radio Engineering; Terman: Radar Electronic Fundamentals, 900 016

Prerequisite: Es-186(C)

Es-831(A) THESIS 2-0

This course provides the student with the opportunity for study and research in connection with the preparation of the thesis as required in Electronics Curriculum. Few formal classes are scheduled, instead the student is concerned with the choice of a suitable topic and does the necessary preliminary library and laboratory work Staff members are consulted as the work progresses

Es-832 THESIS 4-0

This course continues and completes the preparation of the thesis begun in Es-831(A).

Es-836(A) PROJECT SEMINAR 1-0

This course provides the student with the opportunity to prepare a report on the project in which he was engaged during his experience at an industrial laboratory. The student is required to give an oral seminar report.

Es-991(C) and 992(C) INTRODUCTION TO ELECTRONICS 2-0

This course will continue through two consecutive terms and is intended to acquaint the student officer with the general principles, capabilities and limitations of radio, sonar and radar and to give him a limited familiarity with equipment The following topics will be studied in an elementary manner: Resonant circuits, Principles of vacuum tubes, Their actions as oscillation, amplifier, detector, modulation, general principles of transmitters and receivers, both AM and FM, Antennas, wave propagation, basic principles of radar and sonar

Prerequisites: None

GEOLOGY

Ge Courses

Geology, Physical	Ge-101(C)
Geology of Petroleum	Ge-241(C)
Minerology, Determinative	Ge-302(C)
Petrology	Ge-401(C)

Ge-101(C) PHYSICAL GEOLOGY 3-0

This course initiates the student into the study of the various geological phenomena. Among the principle topics discussed are: rock-forming minerals; igneous, sedimentary, and metamorphic rocks; weathe ring and erosion; stream sculpture; glaciation; surface and sub-surface waters; volcanism; dynamic processes; structural geology; and interpretation of topographic maps.

Frequent reference is made to other than the prescribed textbook: The course is given as much as possible to stress those topics of particular interest to the petroleum engineer.

Text: Physical Geology; Longwell, Flint, Knopf.

Prerequisite: None

Ge-241(C) GEOLOGY OF PETROLEUM 2-2

This course includes discussions on the origin, accumulation, and structure which aid in the accumulation of petroleum, its general occurence and distribution. The important oil fields of the world are then taken up in detail as to the occurrence and associated structures in particular fields. The following regions are studied: Eastern United States, Mid-Continent, Gulf Coast, Rocky Mountains, Pacific Coast, North America (except U.S.), West Indies, South America, Europe, Russia, Oceana and Asia. This course is supplemented by reading assignments in the current petroleum and petroleum geology journals.

Text: Principles of Petroleum Geology; Lalicker.

Prerequisite: Ge-101(C)

Ge-302(C) DETERMINATIVE MINERALOGY 1-4

The lectures are designed to familiarize the student with the principles and technique involved in determining minerals in the laboratory. The laboratory periods are spent in the determination of some fifty of the more common minerals by blowpipe, chemical, x-ray diffraction, and crystallographic methods. The student is also made familiar with the methods employed in the use of chemical microscopy for the determination of certain elements.

Texts: Determinative Mineralogy; Lewis, Hawkins; Textbook of Mineralogy: Dama, Ford.

Prerequisite: Cr-301(B)

Ge-401(C) PETROLOGY AND PETROGRAPHY 2-3

The course consists of a series of lectures on the differentiation of magmas into the various igneous rock series on the basis of physical chemical theories; the characteristics, structures and textures of igneous rocks; the sedimentary rocks, their origin and types with particular emphasis on the oil-bearing rocks; the metamorphic rocks, mineral alteration, metamorphism and the resultant rock types. The laboratory work consists of the study of the various rocks in hand specimens, and in thin selections under the petrographic microscope. When practicable, the course is supplemented by trips to nearby localities to study rocks and minerals in the vield.

Text: Rocks and rock minerals; Pirsson, Knopf.

Prerequisites: Ge-101(C), Cr-301(B).

INDUSTRIAL ENGINEERING

IE Lecture Courses

Principles of Industrial Organization I	IE-101(C)
Applied Industrial Organization	IE-103(C)
Psychophysical Systems Research	IE-104(C)

IE-101(C) PRINCIPLES OF INDUSTRIAL ORGANIZATION (Lecture Course) 0-1

A study of the origin and growth of industrial enterprises, principles of organization, control and production, systems research, standards and standardization, industrial relations, and the effects of science upon industry. This course is presented in a series of ten lectures, given by an authority in the field of Management Engineering, covering the material listed above.

Text: None.

Prerequisites: None.

IE-103(C) APPLIED INDUSTRIAL ORGANIZATION (Lecture Course) 0-1

A study of the application of the principles of Industrial Organization to the structure of industrial enterprises. In a series of ten lectures, given by representatives of major industries, an overall picture of the structure of major industrial organizations is presented. The pattern followed is a delineation of the broad aspects of a large organization followed by explanation of the lower echelons of the organization.

Text: None.

Prerequisite: IE-101 or IE-102.

IE-104(C) PHYSCHOPHYSICAL SYSTEMS RESEARCH (Lecture Course) 0-1

A series of five lectures given by authorities in the field of Psychophysical Systems Research covering the background of research in human engineering; quantitative methods employed in psychophysical research and tests; optimum physical conditions of operation of instruments; problems of equipment design; basic research in the design of the instruments; the design of tasks the working enviroment the appraisal and design of systems.

Text: None.

Prerequisities. None

FOREIGN LANGUAGE

La Courses

German	La-101(C)
German	La-102(C)
German	La-103(C)
German	La-104(C)
German	La-105(C)
German	La-106(C)
German	La-107(C)
German	La-108(C)
Russian	La-201(C)
Russian	La-202(C)
Russian	La-203(C)
Russian	La-204(C)
Russian	La-205(C)
Russian	La-206(C)
Russian	La-207(C)
Russian	La-208(C)

La-101(C) GERMAN 2-0

This course will include study of grammar, sufficient for reading intelligently scientific works in German, use of dictionaries, and practice in translating from German to English. The main emphasis will be placed on the acquisition of a large, technical reading vocabulary.

Texts: Shorter College German; Evans, Roseler: Reading German; Morgan, Strothmann: New German Dictionary; Heath.

Prerequisite: None.

La-102(C), La-103(C), La-104(C)
La-105(C), La-106(C), La-107(C) and La-108(C) GERMAN 2-0

These courses are progressive continuations of the course La-101 and follow one another in the order given. Each course is given in a separate term; is an advancement over the preceding course; and leads to the ability to read technical German publications in Meteorology.

Text: An Anthology of Scientific German; Wilde.

Prerequisite: La-101(C) or the preceding listed La-course.

La-201(C) RUSSIAN 2-0

This course will include study of necessary grammatical constructions for reading, use of dictionaries, and practice in translating material from Russian to English. Chief emphasis will be placed on the acquisition of a large, technical reading vocabulary.

Texts: Selections from: Estestvoznznie, Teturev; Geografia, Terchova and Erdeli; Fizichekaya Geografia, Barkov and Polovinkin: Colloguial Russian; Sieff: Russian-English Dictionary; Muller.

Prerequisite: None.

La-202(C), La-203(C), La-204(C)
La-205(C), La-206(C), La-208(C) RUSSIAN 2-0

These courses are progressive continuations of course La-201(C), and follow one another in the order given. Each course is given in a separate term is an advancement over the preceding course; and leads to the ability to read Russian publications in Meteorology.

Texts: As selected.

Prerequisite: La-201(C) or the preceding listed La-course.

Introduction to Engineering Mathematics	Ma-101(C)
Differential Equations and Series	Ma-102(C)
Functions of Several Variables and Vector Analysis	Ma-103(B)
Partial Differential Equations and Related Topics	Ma-104(A)
Fourier Series and Boundary Value Problems	Ma-105(A)
Complex Variable and Laplace Transform	Ma-106(A)
Orthogonal Functions and Integral Equations	Ma-107(A)
Topics in Advanced Calculus	Ma-109(A)
Vector Mechanics and Partial Differential Equations	Ma-134(A)
Numerical Methods and Introduction to Statistics	Ma-134(C)
Matrices and Calculus of Variations	Ma-155(A)
Algebra, Trigonometry and Analytic Geometry	Ma-161(C)
Introduction to Calculus	Ma-162(C)
Special Topics in Calculus	Ma-171(C)
Fourier Series and related topics	Ma-172(C)
Functions of several variables and introduction to vector methods	Ma-173(B)
Introduction to Laplace Transform and Related Topics	Ma-174(B)
Partial Derivatives & Ordinary Differential Equations	Ma-181(C)
Vector Analysis	Ma-182(B)
Complex Variables	Ma-183(B)
Special Mathematical Methods of Physics	Ma-184(A)
Graphical and Mechanical Computation	Ma-201(C)
Graphical and Mechanical Computation	Ma-251(C)
Statistics	Ma-301(B)
Statistics	Ma-331(A)
Statistics I	Ma-351(B)
Statistics II	Ma-352(A)
Mathematical Computation by Physical Means	Ma-401(A)
Mathematical Computation by Physical Means	Ma-451(A)

Ma-101(C) INTRODUCTION TO ENGINEERING MATHEMATICS 5 0

Introduction to infinite series, multiple integrals and differential equations linear equations and determinants; Graeffe s root-squaring method elementary operations with complex numbers

Texts: Higher Mathematics, Sokolnikoff and Sokolnikoff Differential Equations (Revised), Cohen; Elements of the Differential and Integral Calculus Granville Smith and Longley.

Prerequisite: A special review course in differential and integral calculus or equivalent.

Ma-102(C) DIFFERENTIAL EQUATIONS AND SERIES 5 0

A continuation of Ma-101(C). Further study of ordinary differential equations and their applications, stability criteria; systems of linear differential equations with constant coefficients. The Laplace transform Operations on series power series; introduction to elliptic integrals. Fourier series numerical harmonic analysis. Vector algebra and the solid analytic geometry of planes & lines

Texts: Higher Mathematics, Sokolnikoff and Sokolnikoff Elementary Vector Analysis, Weatherburn; New Analytic Geometry Smith Gale and Neeley Calculus Granville, Smith and Longley.

Prerequisite: Ma-101(C).

Ma-103(B) FUNCTIONS OF SEVERAL VARIABLES AND VECTOR ANALYSIS 5 0

A continuation of Ma 102(C). Elementary matrix theory and applications Analytic geometry of curves and surfaces and applications of partial derivatives Differentiation of vectors; differential operators. Line surface and space integrals and applications divergence theorem and theorems of Green and of Stokes. Curvilinear coodinates. Introduction to analytic functions of a complex variable.

Texts: Higher Mathematics Sokolnikoff and Sokolnikoff Elementary and Advances Vector Analysis, Weatherburn; New Analytic Geometry Smith Gale and Neeley; Calculus Granville Smith and Longley.

Prerequisite: Ma-102(C).

Ma-104(A) PARTIAL DIFFERENTIAL EQUATIONS AND RELATED TOPICS 5 0

A continuation of Ma-103(B). Total differential equations and systems of ordinary differential equations Linear and other first order and special cases of higher order partial differential equations with special emphasis on those having constant coefficients. Solution of ordinary differential equations in series; gamma beta Bessel and Legendre functions introduction to boundary value problems and orthogonal functions with applications to heat flow vibrations of strings and membranes and flow of electricity in a cable. Interpolation formulas of Newton, Stirling and Lagrange, guadrature formulas and numerical integration of ordinary differential equations and systems.

Texts: Higher Mathematics, Sokolnikoff and Sokolnikoff Differential Equations (Revised) Cohen Numerical Mathematical Analysis Scarborough

Prerequisite: Ma-103(B).

Ma-105(A) FOURIER SERIES AND BOUNDARY VALUE PROBLEMS 4-0

Derivation of the basic partial differential equations of theoretical physics. Study of the trigonometric, Bessel and Legendre functions, and other systems of orthogonal functions. The Sturm-Liouville theory. Solution of boundary value problems by orthogonal series. Uniqueness of the solution.

Text: Fourier Series and Boundary Value Problems Churchill.

Prerequisite: Ma-104(A).

Ma-106(A) COMPLEX VARIABLE AND LAPLACE TRANSFORM 4-0

Analytic functions; Cauchy's theorem and formula, Taylor and Laurent series, residues, contour integration, conformal mapping. Laplace transform and its use in solving ordinary differential equations; special theorems and manipulations for the Laplace transform; application to partial differential equations and difference equations.

Texts: Introduction to Complex Variables and Applications, Churchill; Modern Operational Mathematics in Engineering; Churchill; Transients in Linear Systems, Gardner and Barnes.

Prerequisite. Ma-104(A) or special permission.

Ma-107(A) ORTHOGONAL FUNCTIONS AND INTEGRAL EQUATIONS 3-0

A study of orthogonal functions and of Sturm-Liouville and other eigenvalue problems illustrated by Fourier series, Bessel functions and the polynomials of Legendre, Hermite, Jacobi and Laguerre, solution of integral equations by the method of interation of Fredholm, and of Hilbert-Schmidt, applications.

Texts: Fourier Series and Boundary Value Problems, Churchill, Fourier Series and Orthogonal Polynomials, Jackson; Mathematics of Physics and Chemistry, Margenau and Murphy.

Prerequisite: Permission of Instructor.

Ma-109(A) TOPICS IN ADVANCED CALCULUS 3-0

Extension of natural numbers to real number system; basic theorems on limits; continuity and differentiation properties of functions; the definite integral and improper definite integrals; infinite series.

Text: Differential and Integral Calculus, Volume I. Courant.

Prerequisite: Ma-104(A) or Ma-1&4(A) or one of these to be taken concurrently.

Ma-134(A) VECTOR MECHANICS AND PARTIAL DIFFERENTIAL EQUATIONS 4-0

Vector equations of motion. Irrotational, colenoidal and linear vector fields. Elementary differential geometry of surfaces. Total differential equations and systems of linear differential equations. Partial differential equations. Introduction to orthogonal functions and boundary value problems with applications to physics.

Texts: Higher Mathematics Sokolnikoff and Sokolnikoff; Advanced Vector Analysis, Weatherburn; Differential Equations Morris and Brown; Fourier Series and Boundary Value Problems; Churchill.

Prerequisite: Ma-103(B).

Ma-135(C) NUMERICAL METHODS AND INTRODUCTION TO STATISTICS 4-0

Numerical interpolation, differentiation and integration. Curve fitting and the method of least squares Elementary alignment charts. Fundamentals of probability. Preliminary considerations in the analysis of observational data. Bernoulli and Poisson distributions.

Texts: Numerical Mathematical Analysis; Scarborough, Theory of Probability, Scheffe, Elementary Statistical Analysis, Wilks; Introduction to Mathematical Statistics Hoel.

Prerequisite. Ma 134(A).

Ma-155(A) MATRICES AND CALCULUS OF VARIATIONS 3-0

Elementary properties and types of matrices; calculus of matrices; latent roots and characteristic vectors of matrices; numerical operations with matrices, application of matrix theory to linear systems of differential equations; matrix methods in the kinematics and dynamics of mechanical systems elements of the calculus of variations.

Texts: Elementary Matrices, Fraxer Duncan and Collar; Introduction to the Calculus of Variations Byerly.

Prerequisites: Ma 104(A) and Mc-102(C).

Ma-161(C) ALGEBRA TRIGONOMETRY AND ANALYTIC GEOMETRY 5-0

Review of elementary algebraic operations. Exponent laws and logarithms. Variables and functions of variables. Coordinate representation of functions; graphs. The trigonometric functions. The straight line and its slope. Simultaneous linear equations. The quadratic equation. Elementary equations of the conics.

Text: A first year of College Mathematics, Brink.

Prerequisite: None

Ma-162(C) INTRODUCTION TO THE CALCULUS 5-0

The limit concept. The derivatives of elementary functions Elementary applications of derivatives. Differentials, higher order derivatives and curvature. The integral as an antiderivative and as an area. Elementary applications of integration. Partial differentiation and total differential.

Text: Elements of the Differential and Integral Calculus (Revised Edition), Granville, Smith and Longley.

Prerequisite: Ma-161(C).

Ma-171(C) SPECIAL TOPICS IN CALCULUS 3-0

Determinants; Taylor's series; introduction to ordinary differential equations of the commonest types; algebra of complex numbers.

Texts: Elements of the Differential and Integral Calculus, Granville, Smith and Longley; USNPS Stencils.

Prerequisite A special review course in differential and integral calculus, or the equivalent.

Ma-172(C) FOURIER SERIES AND RELATED TOPICS 3-0

A continuation of Ma-171(C). Hyperbolic functions; series of functions and Fourier Series; partial derivatives.

Texts: Calculus, Granville, Smith and Longley; Higher Mathematics, Reddick and Miller.

Prerequisite: Ma-171(C) or Ma-101(C).

Ma-173(B) FUNCTIONS OF SEVERAL VARIABLES & INTRODUCTION TO VECTOR METHODS 3-0

A continuation of Ma-172(C). Solid analytic geometry and elementary vector methods; multiple integrals.

Texts: Calculus, Granville, Smith and Longley; Higher Mathematics, Reddick and Miller; USNPS Stencils.

Preprequiste: Ma-172(C).

Ma-174(B) INTRODUCTION TO LAPLACE TRANSFORM & RELATED TOPICS 3-0

A continuation of Ma-173(B). Elementary study of functions of a complex variable; linear differential equations of higher order and systems of such equations; introduction to Laplace Transform.

Texts: Higher Mathematics, Reddick and Miller Complex Variables Churchill; Modern Operational Mathematics in Engineering Churchill

Prerequisite Ma-173(B)

Ma-181(C) PARTIAL DERIVATIVES AND ORDINARY DIFFERENTIAL EQUATIONS 5-0

Partial and total derivatives, normal derivatives differentials implicit functions; line integrals ordinary differential equations of the first order linear differential equations of higher order. Physical applications.

Texts: Higher Mathematics Burington and Torrance; Elements of the Differential and Integral Calculus, Granville Smith and Longley.

Prerequisite: A special review course in differential and integral calculus or the equivalent.

Ma-182(B) VECTOR ANALYSIS 5-0

A continuation of Ma-181(C). Vector algebra derivatives of vectors, vector differential operators differential equations associated with vector fields; double and triple integrals, surface integrals integral relations of the Stokes-Gauss type. Physical applications.

Texts: Elementary and Advanced Vector Analysis Weatherburn; Vector Analysis, Phillips.

Prerequisite Ma-181(C).

Ma-183(B) COMPLEX VARIABLES 5-0

A continuation of Ma-182(B). Algebra of complex numbers elementary transcendental functions analytic functions conformal maps Cauchy s integral formula; Taylor and Laurent expansions residues and contour integrals Fourier series. Mathematical and physical applications.

Texts: Complex Variables Churchill; Fourier Series and Boundary Value Problems, Churchill.

Prerequisite Ma-182(B).

Ma-184(A) SPECIAL MATHEMATICAL METHODS OF PHYSICS 5-0

A continuation of Ma-183(B). Special functions of theoretical physics; calulus of variations; numerical methods; matrices; tensors. Physical applications.

Texts: Mathematics of Physics and Chemistry, Margenau and Murphy; Higher Mathematics, Burington and Torrance.

Prerequisite: Ma-183(B).

Ma-201(C) GRAPHICAL AND MECHANICAL COMPUTATION 0-2

Construction of nomograms, including alignment charts by geometric methods and use of determinants. Improvement of charts by projection. The use of coordinate paper. The theory and use of the planimeter and integrator.

Text: The construction of Nomographic Charts; Mavis.

Prerequisite: Ma-101(C) or Ma-171(C) or one of these to be taken concurrently.

Ma-251(C) GRAPHICAL AND MECHANICAL COMPUTATION 0-4

The course consists of twenty exercises each occupying one laboratory period. Two exercises are in the theory and use of the planimeter and integrator. The remaining exercises are devoted to the design of diagrams, including: construction of scales to show relations between two variables; construction of nomograms with families of lines or curves to show relations among three variables; alignment diagrams for three variables involving curved scales and curve nets; diagrams for more than three variables and diagrams with more than one index line; alignment diagrams with adjustment for equations in three or more variables; the Lafay-Wertheimer method for constructing a chart or alignment diagram from empirical curves.

Text: Design of Diagrams for Engineering Formulas, Hewes and Seward.

Prerequisite: Ma-101(C) or Ma-171(C) on one of these to be taken concurrently.

Ma-301(B) STATISTICS 3-2

Fundamental principles of probability. Probability distributions with special emphasis on the binomial, Poisson and normal distributions. Simple and multiple regressions and correlation. Distfibution of mean, chi-square, variance, t and F. Analysis of variance. Tests of statistical hypotheses.

Texts: Elementary Statistical Analysis, Wilks; Introduction to Mathematical Statistics, Hoel.

Prerequisite: Ma-103(B) (may be taken concurrently).

Ma-331(A) STATISTICS 4-2

A continuation of Ma-135(C). Continuous frequency distributions. Moments and mathematical expectation. The normal and type III Pearson distributions. Correlation: simple, multiple and partial. Non-linear regressions. Large and small sampling theory and the testing of hypotheses. Applications to problems in aerology.

Texts: Elementary Statistical Analysis, Wilks; Introduction to Mathematical Statistics, Hoel.

Prerequisite: Ma-135(C).

Ma-351(B) STATISTICS I 2-2

Fundamental principles of probability. Probability distributions with special emphasis on the hypergeometric, binomial, Poisson and normal distributions. Distribution of sample mean.

Texts: Elementary Statistical Analysis, Wilks; Introduction to Mathematical Statistics, Hoel.

Prerequisite: Ma-155(A).

Ma-352(A) STATISTICS II 1-2

A continuation of Ma-351(B). Simple and multiple regressions and correlation. Distribution of correlation coefficient, chi-square, variance, t and F. Analysis of variance. Tests of statistical hypotheses. Introduction to quality control. sampling inspection programs and sequential analysis.

Texts: Introduction to Mathematical Statistics, Hoel; Economic Control of quality of Manufactured Product, Shewhart; Standard Sampling Inspection Procedures of U.S. Navy.

Prerequisite. Ma-351(B).

Ma-401(A) MATHEMATICAL COMPUTATION BY PHYSICAL MEANS 2-2

A wide variety of elementary devices which may be used to perform mathematical operations is considered together with instruments which combine them so as to solve problems largely without human intervention.

Text: Theory of Mathematical Machines, Murray.

Prerequisite: Ma-103(B).

Ma-451(A) MATHEMATICAL COMPUTATION BY MECHANICAL MEANS 3-2

The theory and details of design of a wide varity of elementary and compound devices which may be used to perform mathematical operations physically are studied. Their relations to ordinance problems and equipment are considered. In as far as possible some of the subject material is presented to the class by the students in informal reports. Ten hours are devoted to further study of the material in numerical analysis presented in Ma-104(A) and to further topics in this field including Lozenge diagrams, symbolic methods, Euler's formula, Gauss's formula, cubature.

Texts: Theory of Mathematical Machines Murray; Computing Mechanisms, Svoboda; Numerical Mathematical Analysis, Scarborough.

Prerequisite: Ma-103(B)

Statistics and Kinematics	Mc-101(C)
Plane Dynamics	Mc-102(C)
Space Dynamics	Mc-103(C)
Methods in Dynamics	Mc-201(A)
Vibrations	Mc-311(A)
Exterior Ballistics	Mc-401(A)
Dynamics of Missiles and Gyros	Mc-402(A)
Interior Ballistics	Mc-421(A)
Strength of Guns	Mc-431(A)
Statics of Structures	Mc-801(C)

Mc-101(C) STATICS AND KINEMATICS 3-0

Fundamental axioms of mechanics; the free body; resolution and composition of forces; moments; conditions of equilibrium; distributed forces; trusses, cables and beams; friction; space statics; method of work; stability of equilibrium; kinematics and dynamics of a particle.

Text: Mechanics, Den Hartog.

Prerequisite: A special review course in mechanics, or the equivalent.

Mc102(C) PLANE DYNAMICS 3-0

Kinematics of plane motion of a rigid body; moments and products of inertia; dynamics of plane motion of a rigid body; work and potential energy; impulse and momentum; relative motion and the Coriolis law; gyroscopes; dimensional analysis.

Text: Mechanics, Den Hartog.

Prerequisite: Mc101(C)

Mc-103(C) SPACE DYNAMICS 2-0

Space kinematics; angular velocity; general motion of a rigid body; moments and products of inertia; momental ellipsoid; principal axes; kinetic energy and angular momentum of rigid bodies; space dynamics; moving frames of reference; Euler's equations.

Texts: Principles of Mechanics (2nd edition), Synge and Griffith;
Advanced Dynamics, Timoshenko and Young.

Prerequisite: Mc-102(C)

Mc-201(A) METHODS IN DYNAMICS 2-2

The principles of (a) linear momentum, (b) angular momentum, (c) work and energy, (d) power and energy, (e) conservation of energy, (f) virtual work, and (g) d'Alembert are developed and discussed in detail. This work is followed by a development and interpretation of Lagrange's equations of motion. The application of these various principles to obtain the differential equations of motion of dynamical systems is given particular attention. Numerous exercises in the writing of differential equations of motion are assigned. Some of these exercises are designed to furnish practice in the formulation of the differential equations for systems of variable mass.

Texts: Principles of Mechanics, Synge and Griffith;
Advanced Dynamics, Timoshenko and Young.

Prerequisites: Mc-102(C) and Ma-103(B) (latter may be taken concurrently).

Mc-311(A) VIBRATIONS 3-2

Kinematics of vibrations, harmonic analysis; free and forced vibrations of systems with one degree of freedom; theory of vibration measuring instruments and of vibration insulation; systems with many degrees of freedom; normal modes of vibration; computation of fastest and slowest modes by matrix methods; vibrations of strings, beams, shafts and membranes. Rayleigh's method; Stodola's method; critical speeds; selfexcited vibrations; Lagrangian equations of motion.

Texts: Mechanical Vibrations (3rd edition), Den Hartog;
Advanced Dynamics, Timoshenko and Young.

Prerequisites: Ma-104(A), Mc-102(C) and ME-500(C).

Mc-401(A) EXTERIOR BALLISTICS 3-0

Topics presented include the vacuum trajectory; density and temperature structure of the atmosphere; application of dimensional analysis to the problem of air resistance; theory of longitudinal elastic waves in air; numerical integration of differential equations of motion under standard conditions; differential corrections for abnormal conditions; weighting factors; integration of the adjoint system, exact and approximate construction of firing tables for aircraft machine guns. The projectile is treated as a mass particle, stability considerations being deferred to a later course, Mc-402(A)

Text: A Course in Exterior Ballistics, Ritter

Prerequisites: Ma-155(A) and Mc102(C).

Mc-402(A) DYNAMICS OF MISSILES AND GYROS 3-0

The fundamental principles of the dynamics of rotating rigid bodies are emphasized throughout the course. These prenciples are applied to a variety of mechanical systems in an effort to demonstrate their wide applicability. Among the applications discussid are the motion of a gyroscope in the gyrocompass latitude measuring devices and stable elements, the stability, drift and trailing of spinning shells and rockets in flight.

Texts: Principles of Mechanics (2nd edition), Synge and Griffith,
Motion of a Spinning Shell, Nielsen and Synge
Advanced Dynamics, Timoshenko and Young

Prerequisites: Mc-401(A).

Mc-421(A) INTERIOR BALLISTICS 2-0

Those thermodynamic and mechanical concepts which are fundamental to all interior ballistics systems are treated early in the course. These topics are followed by a detailed study (including computational exercises) of the Hirschfelder system as developed under NDRC auspices. The contributions of modern interior ballistic theory to the problem of gun design is emphasized.

Text: OSRD Report 6468, Interior Ballistics.

Prerequisites: Ma-101(C), Mc-102(C), Ch101(C)

Mc-431(A) STRENGTH OF GUNS 3-0

A review of the fundamental principles in the theory of elasticity and strength of materials is presented in the first part of the course; This is followed by a discussion of those theories of strength which have been employed in the design of guns. Detailed studies, with accompanying computational exercises, are made of the maximum strain theory for the case of built up guns, and of the Dugeut Theory of radial expansion.

Text: Naval Ordnance (1933 edition); Treatise on the Radial Expansion of Guns, Jeansen; Study of the Transverse Resistance of Tubes, Malaval.

Prerequisite: Ma-102(C), Mc-102C and ME-500(C)

Mc-801(C) STATICS OF STRUCTURES 2-0

Graphical statics; the funicular polygon; simple trusses; the Maxwell-Cremona diagram; phantom members; statically determinate constraint of a rigid body in a plane; compound trusses; complex trusses; Henneberg's method; distributed forces in a plane; statically determinate of a rigid body in space; simple, compound and complex space frames; moments and products of inertia of lamina; rotation of axes; Mohr's circle; ellipses of inertia and gyration.

Texts: Analytical Mechanics for Engineers (3rd edition), Seely and Ensign; Engineering Mechanics (Statics) Timoshenko and Young

Prerequisite: A Special review course in mechanics, or the equivalent.

MECHANICAL ENGINEERING

ME Courses

Engineering Thermodynamics	ME-111(C)
Engineering Thermodynamics, Continued	ME-112(B)
Engineering Thermodynamics, Continued	ME-122(C)
Engineering Thermodynamics	ME-131(C)
Engineering Thermodynamics, Continued	ME-132(C)
Engineering Thermodynamics	ME-141(C)
Engineering Thermodynamics, Continued	ME-142(A)
Engineering Thermodynamics, Continued	ME-143(A)
Marine Power Plant Equipment	ME-211(C)
Marine Power Plant Equipment, Continued	ME-212(C)
Marine Power Plant Analysis	ME-215(B)
Marine Power Plant Design	ME-216(A)
Internal Combustion Engines (Diesel)	ME-217(C)
Marine Power Plant Equipment	ME-221(C)
Marine Power Plant Equipment	ME-222(C)
Marine Power Plant Analysis	ME-223(C)
Marine Power Plant Analysis	ME-224(B)
Heat Transmission	ME-310(B)
Hydro Mechanics	ME-411(C)
Hydrodynamics	ME-412(A)
Hydro Mechanics	ME-421(C)
Hydro Mechanics, Continued	ME-422(B)
Strength of Materials	ME-500(C)
Strength of Materials	ME-511(C)
Strength of Materials, Continued	ME-512(A)
Theory of Elasticity	ME-513(A)
Strength of Materials	ME-520(C)

Strength of Materials	ME-540(C)
Strength of Materials	ME-542(B)
Materials Testing Laboratory	ME-601(C)
Materials Testing Laboratory	ME-611(C)
Experimental Stress Analysis	ME-612(A)
Experimental Stress Analysis	ME-632(B)
Kinematics of Machinery	ME-700(C)
Mechanics of Machinery	ME-711(C)
Dynamics of Machinery	ME-712(A)
Dynamics of Machinery	ME-730(B)
Machine Design	ME-811(C)
Machine Design, Continued	ME-812(B)
Machine Design	ME-830(C)
Manufacturing Engineering	ME-840(C)

ME-111(C) ENGINEERING THERMODYNAMICS 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy function, Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic properties of liquids and v[a]pors in equilibrial and metastable states, property tables and diagrams, representative reversible and irreversible Processes in vapor and liquid phases. Property relations, tables and diagrams for ideal or quasi-ideal gases, representative reversible and irreversible processes with these, kinetic theory of gases. Associated problems.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: Ma-102(C)

ME-112(B) ENGINEERING THERMODYNAMICS, CONTINUED 4-2

Properties of mixtures of quasi-ideal gases, low-pressure gas-vapor mixtures and related indices, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion and other representative processes, multi-and mono-pressure hygrometric diagrams. Non-ideal gases, their p-v-T correlation by equation and by compressibility diagrams, residual enthalpy and entropy functions and their determination from compressibility and throttling data, representative processes and generation of thermodynamic diagrams. Combustion of fuels and material balances, fuel calorimetry, chemical equilibrium and equilibrium constant, rich-mixture and thin-mixture combustion, flame temperatures. Associated problems.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: ME-111(C)

ME-122(C) ENGINEERING THERMODYNAMICS, CONTINUED 3-2

Studies included are as indicated for course ME-112 except for omission of considerations of the thermodynamic properties and property correlations for non-ideal gases.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: ME-111(C)

ME-131(C) ENGINEERING THERMODYNAMICS 4-2

Stored and transitional energies, their accounting by energy equations in dynamic and chemical processes. Aspects of reversibility, thermodynamic scale of temperature, entropy of energy and the entropy property, Second and Third Laws of thermodynamics, Maxwell relations. Phase rule, thermodynamic characteristics of liquids and vapors. Property relations, tables and diagrams for ideal or quasi-ideal gases and representative reversible and irreversible processes with these. Gas mixtures, low pressure gas-vapor mixtures and their indices, saturation by isobaric cooling, isobaric evaporation and adiabatic expansion, multi-and mono-pressure hygrometric charts.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: Ma-102(C).

ME-132(C) ENGINEERING THERMODYNAMICS, continued 3-2

Combustion of fuels and material balances. Internal combustion power cycles, elementary gas turbine power plant, influences of regenerative preheating, reheating et cetera, performance in rices. Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of the jet and diverted flow Associated problems.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart.

Prerequisite: ME-131(C)

ME-141(C) ENGINEERING THERMODYNAMICS 4-2

The fundamental concepts of thermodynamics; energy and its accounting; availability and entropy of energy; the thermodynamic properties of pure substances and their changes in various processes, including chemical interaction. Emphasis is placed on those topics essential for subsequent studies of torpedo power plants, jet engines, explosives and similar applications where non-standard fluids are involved.

The laboratory periods are used for student solution of practical problems chosen to illustrate the principles discussed in the classroom.

Text: Principles of Engineering Thermodynamics, Kiefer, Stuart & Kinney.

Prerequisite: Ma-103(B)

ME-142(A) ENGINEERING THERMODYNAMICS. Continued 2-2

Organization of the thermodynamic properties of non-ideal gases through the use of the residual unctions preparation and use of thermodynamic diagrams for simple systems of ideal and non-ideal gases and for complex systems in chemical equilibrium, heat and work effects in representative processes involving complex mixtures such as the products of combustion. This course is a continuation of ME-141

The laboratory periods are used for student solution of practical problems to illustrate the principles discussed in the classroom.

Text Principles of Engineering Thermodynamics, Kiefer, Stuart & Kinney.

Prerequisite ME-141(C)

ME-143(A) ENGINEERING THERMODYNAMICS. Continued 4-4

Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of the jet and diverted flow. Application of thermodynamic facilities to power plants such as jet engines and torpedo motors which operate on non-standard fluids. Turbine nozzle and blading design factors and performance indices. Elements of heat transfer. Associated problems

Text: Principles of Engineering Thermodynamics; Kiefer, Kinney and Stuart.
Steam turbine; Church

Prerequisite ME-142(C)

ME-211(C) MARINE POWER PLANT EQUIPMENT 3-2

Steam power plant cycles, influence of regerative feed heating and of reheating, performance indices, Internal combustion power cycles, elementary gas turbine power plant, influences of regerative preheating and of reheating, performance indices. Thermodynamic aspects of the flow of compressible fluids in nozzle, diffuser and duct, compressive shocks, dynamics of jet and of diverted flow. Marine boiler performance analysis and characteristics. Associated problems and laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart: miscellaneous supplementary material.

Prerequisite: ME-112(B)

ME-212(C) MARINE POWER PLANT EQUMPMENT, continued 3-4

Thermodynamic aspects of the turbine, impulse and reaction types, of the reciprocating engine, the gas compressor and blower. Refrigeration and heat pump cycles, refrigerants, multi-level refrigeration. Air conditioning; requirements and equipment, Associated laboratory work.

Text: Engineering Thermodynamics; Kiefer, Kinney & Stuart: Refrigeration and Air Conditioning; Raber & Hutchinson; miscellaneous supplementary material.

Prerequisite: ME-211(C)

ME-215(B) MARINE POWER PLANT ANALYSIS 2-4

The studies include preliminary methods of estimating for a hypothetical naval ship the main and auxiliary power requirements, inter-relationship of individual equipment items, and computation of various plant performance indices; the evaluation of flow diagrams and heat balance analysis of representative naval power plants. The P.W. periods are largely used in related computations and compilations.

Text: Marine Engineering; Seward.

Prerequisites: ME-212(C), ME-310(B), and ME-411(C)

ME-216(A) MARINE POWER PLANT DESIGN 2-4

This course, in continuation of ME-215, includes additional heat balance analyses of representative naval power plants. It further includes studies of the design methods employed in the over-all planning of power plants, of their principal components, and the various practical factors and special military requirements which influence the design. The available time is distributed between student project work, seminar, and lectures by authorities in the various specialized fields of naval marine engineering.

Text: Marine Engineering; Seward: Bureau Ships publications and data.

Prerequisites: ME-215(B)

ME-217(C) INTERNAL COMBUSTION ENGINES (Diesel) 4-2

The studies include the thermodynamic analysis of the fundamental cycle, ideal and actual combustion processes, cyclic processes, injection phenomena and methods of injection system analysis, and the variables that effect the efficiency and performance of the engine.

The laboratory work included a series of tests on various engines to determine volumetric and mechanical efficiency, speed-torque characteristics, fuel consumption rates, effect of injection system variables upon engine performance, analysis of high speed engine indicator card, etc.

Text: Internal Combustion Engines; Lichty: Internal Combustion Engines; Taylor & Taylor.

Prerequisites: ME-112(B) or 122(C)

ME-221(C) MARINE POWER PLANT EQUIPMENT 3-2

Steam power plant cycles, influences of regenerative feed heating and of reheating, performance indices. Internal combustion power cycles, elementary gas turbine power plant, influence of regenerative preheating and of reheating, performance indices. Thermodynamic aspects of flow of compressible fluids in nozzle, diffuser and duct, dynamics of jet and of diverted flow. Elements of heat transmission. Marine boiler performance analysis and characteristics. Associated problems and laboratory work.

Text: Engineering Thermodynamics; Kiefer, Stuart & Kinney: miscellaneous supplementary material.

Prerequisite: ME-122(C)

ME-222(C) MARINE POWER PLANT EQUIPMENT, Continued 3-4

Thermodynami aspects of the turbine, impulse and reaction types, of the reciprocating engine, the gas compressor and blower. Refrigeration and heat pump cycles, refrigerants, multi-level refrigeration, Air conditioning requirements and equipment. Associated laboratory work.

Text: Engineering Thermodynamics: Kiefer, Kinney & Stuart: Miscellaneous supplementary material.

Prerequisite: ME-221(C)

ME-223(C) MARINE POWER PLANT ANALYSIS 2-0

The studies include preliminary methods of estimating for a hypothetical naval ship the main and auxillary power requirements, inter-relationship of individual equipment items, and computation of various plant performance indices.

Text: Marine Engineering; Seward.

Prerequisites: ME-222(C) and ME-421(C)

ME-224(B) MARINE PLANT ANALYSIS, continued 0-6

This course, in continuation of ME-223(C) includes studies of representative naval power plants by analysis of their heat balance and flow diagrams, and of the practical factors and special military requirements that influence naval power plant design.

Texts: Marine Engineering; Seward: Bureau Ships publications and data.

ME-310(B) HEAT TRANSMISSION 3-2

General manners of energy transition by temperature potential, characteristic thermal circuits, concepts and correlation of individual and overall heat transfer coefficients. Fourier's general law of conduction, applications to representative steady-state situations and unsteady-state conditions, Schmidt and relaxation methods of approximation. Convection phases of thermal circuits, free and forced, and ones involving vaporization and condensation. Heat radiation. Associated problems and laboratory work.

Text: Heat Transmission; Jakob: miscellaneous supplementary material.

Prerequisites: ME-112(B), 411(C)

ME-411(C) HYDROMECHANICS 3-2

The mechanical properties of liquids, hydrostatic pressures and forces on submerged surfaces and associated matters of buoyancy and ship stability Energy aspects of liquid flow, the resistance to such flow through pipes, liquid flow metering and control, hydraulic force-transmission and arrester systems. Dynamic forces associated with flow through confining channels, the centrifugal pump and hydrodynamic coupling, etc. The principle of dynamic similarity and dimensional analysis are developed and employed extensively. The P.W. periods are used for student's solution of related practical problems and for related laboratory tests.

Text: Mechanics of Hydraulic Equipment; PG Stencil No. 2217

Prerequisite: Ma-103(B)

ME-412(A) HYDRODYNAMICS

Fluid-flow kinematic concepts; fundamentals of frictionless fluid flow; theorems and basic flow definitions; three dimensional flow examples, application of complex variables to two-dimensional fluid flow; two dimensional flow examples; Blasius theorem - flow around cylinders and airfoils; Schwarz-Christoffel theorem - free streamlines; vortex motion; equations for viscous flow; the boundary layer.

Text: Fluid Dynamics; Streeter.

Prerequisites: ME-411(C) and Ma-104(A).

ME-421(C) HYDROMECHANICS 3-2

Mechanical properties of fluids; hydrostatic pressures and forces; buoyancy and stability; Energy of flow; resistance to flow; fluid flow metering; hydraulic force and arrester systems.

Text: PG Stencil No. 2217, Mechanics of Hydraulic Equipment.

Prerequisites: Ma-103(B) or the equivalent.

ME-422(B) HYDROMECHANICS, Continued 2-2

Dynamic forces associated with fluid flow; centrifugal pumps; hydrodynamic coupling; dimensional analysis and dynamical similarity. Introduction to the Kinematics of flow; stream function and velocity potential; graphical mapping of stream lines.

Text: PG Stencil No. 2217, Mechanics of Hydraulic Equipment.

Prerequisites: ME-431(C) and Ma-103(B) or the equivalent.

ME-500(C) STRENGTH OF MATERIALS 3-0

Elements of the mechanics of elastic bodies; tensile and compressive stresses, shearing stress, Hooke's law, thin-walled cylinders, combined stresses, analysis of plane strain, torsion of circular sectioned members, elementary beam theory, combined loadings and columns.

Text: Elements of Strength of Materials; Timoshenko & MacCullough.

Prerequisites: Ma-101(C) and Mc-801(C) or equivalent

ME-511(C) STRENGTH OF MATERIALS 5-0

Topics in elastic-body mechanics, including tensile and compressive stresses, shearing stress, Hook's law, this-walled cylinders, combined stresses, analysis of plane strain, torsion of circular-sectioned members, elementary beam theory, statically indeterminate problems in bending, beams on elastic foundations.

Text: Strength of Materials, Vols. I & II, Timoshenko.

Prerequisites: Ma-101(C) and Mc-801(C) or equivalent.

ME-512(A) STRENGTH OF MATERIALS, Continued 5-0

Beam-columns, problems having radial symmetry, combined loading, columns, strain energy, thin plates, thick-walled cylinders, fundamental concepts in the theory of elasticity.

Text: Strength of Materials, Vols. I & II, Timoshenko

Prerequisite: ME-511(C)

ME-513(A) THEORY OF ELASTICITY 3-0

Plane-stress considerations, differential equations of equilibrium and compatability, the Airy stress function, curvilinear coordinates, problems in plane stress and plane strain, three-dimensional stress considerations, St. Venant theory of torsion, energy considerations.

Text: Theory of Elasticity, Timoshenko.

Prerequisite: ME-512(A) or the equivalent.

ME-520(C) STRENGTH OF MATERIALS 5-0

Elements of the mechanics of elastic bodies; tensile and compressive stresses, Hooke's law, thin-walled cylinders, analysis of plane strain, torsion of circular-sectioned members, elementary beam theory, Euler column theory.

Text: Elements of Strength of Materials, Timoshenko & MacCullough.

Prerequisites: Ma-171(C) and Mc-801(C) or the equivalent

ME-540(C) STRENGTH OF MATERIALS 5-0

Topics in elastic-body mechanics, including plane and three-dimensional stress, general strain, Hook's law, thin-walled cylinders, torsion of circular shaft, elementary beam theory, columns, frames, beams on elastic foundations, beam-columns, thin plates, thick-walled cylinders, theories of failure.

Text: Strength of Materials, Vols. I & II, Timoshenko.

Prerequisites: Ma-101(C) and Mc-801(C) or equivalent.

ME-542(B) STRENGTH OF MATERIALS, con'd. 3-0

Statically indeterminate problems in bending, bending beyond the yield point, curved beams, strain energy, mechanical properties of materials

Text: Elements of Strength of Materials, Timoshencko & MacCullough

Prerequisite: ME-500(C) or ME-511(C)

ME-601(C) MATERIALS TESTING LABORATORY 0-2

Performance and analysis of standard tests used in determining the mechanical properties of engineering materials, including ones in tension, compression, torsion, shear, transverse, bending, impact, hardness and fatigue.

Text: Testing of Engineering Materials, Muhlenbruch; A S.T.M. Student Standards.

Prerequisite: Subsequent to or concurrent with ME-500(C), 520(C) or 540(C)

ME-611(C) MATERIALS TESTING LABORATORY 2-2

Study of the theories of failure, the evaluation of experimental error and experiments involving most of the standard and some non-standard tests used in the determination of the mechanical properties of engineering materials. These tests include: Tension, compression, torsion, shear, transverse bending, impact, hardness, fatigue and column.

Text: Strength of Materials, Vol. II, Timoshenko: Testing and Inspection of Engineering Material, Davis, et al.

Prerequisites: ME-511(C)

ME-612(A) EXPERIMENTAL STRESS ANALYSIS 3-2

The course outline includes: dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscellaneous methods in experimental stress analysis. Diversified laboratory projects will be assigned offering an opportunity to apply the methods of experimental stress analysis to the solution of both static and dynamic problems. The Begg' deformator will be used as a check on stress resultants and in determining reaction values for loading models.

Text: Introduction to Experimental Stress Analysis; Lee

Prerequisites: ME513Aand ME-611(C). ME612(A) may be taken concurrently with ME-513(A)

ME-632(B) EXPERIMENTAL STRESS ANALYSIS 2-2

The course outline includes: Introduction to the theory of elasticity, dimensional analysis, strain gage techniques, photoelasticity, brittle lacquer method, membrane analogy, miscelaneous methods in experimental stress analysis. Laboratory projects will be assigned in which the various facilities available in experimental stress analysis will be used.

Text: Introduction to Experimental Stress Analysis; Lee

Prerequisite: ME-512(A) or Ae-204(A) and ME-601(C)

ME-700(C) KINEMATICS OF MACHINERY 3-2

This is a general service course. The following topics are studied: Linkwork, cams, toothed gearing, trains of mechanisms, velocities, accelerations, static forces and inertia forces in machine members.

The practical work periods are devoted to the solution on the drawing board of selected problems.

Text: Mechanics of Machinery; Ham & Crane

Prerequisite: MC-102(C)

ME-711(C) MECHANICS OF MACHINERY 3-2

Topics considered briefly include link-works, cams and gears. Major emphasis is on the velocities and accelerations of moving parts, static and inertia forces and their balancing, critical speeds in shafts.

Text: Mechanics of Machinery; Ham & Crane

Prerequisite: Mc-102(C)

ME-712(A) DYNAMICS OF MACHINERY 3-2

Studies are made of the following topics: Balancing of solid rotors, torsional vibrations by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the reciprocating engine. Laboratory work includes the following experiments: balancing a solid rotor on a mechanical as well as an electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment, and operating a torsional vibration inducer unit.

Text: Mechanical Vibrations, J.P. Den Hartog; Notes by E. K. Gatcombe.

Prerequisites: Ma-104(A), Mc-201(A), ME-711(C) and 511(C)

ME-730(B) DYNAMICS OF MACHINERY 3-2

Studies are made of the following topics: Balancing of solid rotors, torsional vibration analysis by the Holzer method, single and two degrees of freedom linear vibrating systems with and without damping, tuned pendulum absorbers, harmonic analysis of the radial aircraft engine. The laboratory work includes the following experiments: balancing of solid rotors on the mechanical as well as the electrical balancing machine, vibrating linear damped vibration absorbers on the Westinghouse equipment, and operating a torsional vibration inducer unit.

Texts: Mechanical Vibrations, J. P. Den Hartog: Notes, E. K. Gatcombe.

Prerequisites: Ma-104(A), Mc-201(A), Ae-202(C)

ME-811(C) MACHINE DESIGN 3-2

Review of strength of materials, selection of materials, stress-concentration, bearings, fits and tolerances. Several short design projects as follows: Tabulation of tolerances for shafts and holes for the various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw, and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams, and thin and thick cylinders.

Texts: Design of Machine Elements, Vallance: Notes, E.K. Gatcombe.

Prerequisites: Me-520(C) or equivalent, ME-700(C)

ME-812(B) MACHINE DESIGN, Continued 3-4

Several practical design projects will be completed on the drawing board. The projects will give the students an opportunity to combine theory with practice. The drawings involved in the projects will be completely dimensioned, proper materials selected, correct base references, surfaces for machining and inspecting will be chosen, proper fits and tolerances will be chosen for interchangeable manufacture. The objective is to create designs which may actually be fabricated.

Texts: Notes, E. K. Gatcombe.

Prerequisites: ME-811(C)

ME-830(C) MACHINE DESIGN 4-2

Review of Strength of Materials, Selection of Materials for different designs, Stress-concentration, bearing design, fits and tolerances. Several short design projects as follows: Tabulation of tolerances for shafts and holes for various classes of fits, accumulation of tolerances in machines, design of an armature shaft, spring design, screw fastening design, design of a power screw, and the design of a set of gears. Studies of belt and chain drives, brakes, clutches, cams, and thin and thick cylinder design.

Texts: Design of Machine Members, Vallance: Notes, E. K. Gatcombe.

Prerequisites: ME-700(C), Ae-202(C)

ME-840(C) MANUFACTURING ENGINEERING 3-2

The following topics are studied: The principles of interchangeable manufacture, the selection of and use of the proper machine tools to fulfill a specific requirement, the details of gage design and inspection methods with reference to proper fits and tolerances. Several industrial plants will be visited where lectures on the use of machines will be provided.

Texts: Interchangeable Manufacturing, E. Buckingham

Prerequisites: ME-811(C)

AEROLOGY

Mr Courses

Fundamentals of Atmospheric Circulation	Mr-101(C)
Radiological Defense	Mr-110(C)
Introduction to Synoptic Meteorology	Mr-200(C)
Weather Maps and Codes	Mr-201(C)
Surface Weather Maps Analysis and Forecasting	Mr-202(C)
Weather Analysis and Forecasting	Mr-203(C)
Advanced Weather Analysis and Forecasting	Mr-204(C)
Upper-Air Analysis	Mr-205(C)
Introduction to Synoptic Meteorology	Mr-210(C)
Weather Maps and Codes	Mr-211(C)
Surface Weather Map Analysis	Mr-212(C)
Map Analysis and Forecasting	Mr-213(C)
Weather Analysis and Forecasting	Mr-214(C)
Weather Analysis and Forecasting	Mr-221(B)
Weather Analysis and Forecasting	Mr-222(B)
Advanced Weather Analysis and Forecasting	Mr-223(B)
Advanced Weather Analysis and Forecasting	Mr-224(B)
Upper-Air Analysis	Mr-225(B)
Southern Hemisphere and Tropical Meteorology	Mr-228(A)
Selected Topics in Applied Meteorology	Mr-229(A)
Synoptic Meteorology I	Mr-301(C)
Synoptic Meteorology II	Mr-302(C)
Dynamic Meteorology I	Mr-321(A)
Dynamic Meteorology II	Mr-322(A)
Dynamic Meteorology III	Mr-323(A)
Meteorological Charts and Diagrams	Mr-402(C)
Physical Meteorology	Mr-403(C)

Wave, Swell and Surf Forecasting	Mr-404(C)
Meteorological Instruments	Mr-410(C)
Thermodynamics of Meteorology	Mr-411(B)
Physical Meteorology	Mr-412(A)
Wave, Swell and Surf Forecasting	Mr-420(A)
The Upper Atmosphere	Mr-422(A)
Climatology	Mr-510(C)
Seminar	Mr-810(C)
Thesis I	Mr-921(A)
Thesis II	Mr-922(A)

Mr-101(C) FUNDAMENTALS OF ATMOSPHERIC CIRCULATION 3-0

This course serves as an introductory course in Meteorology, especially as it concerns large-and small-scale circulations, and the variations of these with height. It is designed primarily to give student officers in related subjects the required meteorological backgrounds, and, at the same time, to outline possible inter-relationships between the subjects.

Text: Introduction of Meteorology; Petterssen

Prerequisites: None

Mr-110(C) RADIOLOGICAL DEFENSE 2-0

This course is devoted to discussions of explosion phenomena, the effects of blast and radiation, the aerological problem of fall-out, decontamination, and organization and training for Radiological Defense.

Text: USF 85

Prerequisites: Ph-190(C); Mr-302(C); for MA group. Mr-323(A) for M2 and MS groups

Mr-200(C) INTRODUCTION TO SYNOPTIC METEOROLOGY 3-0

This course serves as a preparation for advanced study of synoptic meteorology. It is primarily an introduction to synoptic meteorology as a survey course, considering in turn the composition of the atmosphere, general circulation, air masses and air-mass changes, fronts, cyclones and anticyclones, weather analysis and weather forecasting.

Text: Introduction to Synoptic Meteorology; Petterssen

Prerequisites: None

Mr-201(C) WEATHER MAPS AND CODES 2-12

This course is concerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing; the reduction of the observed facts into short coded messages; and the decoding and plotting of the date on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the principles of meteorology. Finally, the students analyze an idealized and a three-hourly series of weather maps.

Texts: Hydrographic Office Publication H.O. 206: U.S. Weather Bureau-Circulars "S" and "N", RadiosondeCode, International Code: Aerographer's Manual.

Prerequisites: None

Mr-202(C) SURFACE WEATHER MAP ANALYSIS AND FORECASTING 2-12

The principles of surface weather map analysis are demonstrated by having the students analyze current daily weather charts; correlate upper wind data with the surface charts; observe the local surface weather elements; discuss the map analysis; and make trial forecasts.

Text: Handbook of Meteorology; Berry, Bollay, Beers: Practical Aids in Weather Map Analysis; Lockhart: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-200(C); Mr-201(C).

Mr-203(C) WEATHER ANALYSIS AND FORECASTING 2-12

This course is a continuation of course Mr-202(C). More advanced methods of current weather map analysis and forecasting are presented; and emphasis is placed on the application of analysis and forecast techniques previously presented in the theoretical courses. The students are taught the usefulness of upper air observations in determining air-mass characteristics, movements, etc. Daily forcasts and map discussions are included.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Constant Pressure Analysis; NavAer 50-1R-177: Constant Pressure and Differential Analysis; Haltiner, Eaton: A Collection and Evaluation of Weather Forecasting Rules; NavAer 50-1R-204.

Prerequisites: Mr-202(C); Mr-301(C); Mr-402(C).

Mr-204(C) ADVANCED WEATHER ANALYSIS AND FORECASTING 0-15

This course is a continuation of course Mr-203(C). The student officers are taught to analyze and forecast the weather in accordance with the most advanced applied methods, using all available sources of information, including the surface maps, upper-level charts, wind-aloft dats, and meteorograph and radiosonde observations. The course is coordinated with course Mr-205(C), where in the upper level charts are drawn, and differential analysis, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Text: None

Prerequisites: Mr-203(C); Mr-302(C); Mr-403(C)

Mr-205(C) UPPER AIR ANALYSIS 0-10

The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-204(C) including constant-pressure analysis, cross-sections, etc.

Text: None

Prerequisites: Mr-302(C); Mr-203(C); Mr-403(C)

Mr-210(C) INTRODUCTION TO SYNOPTIC METEOROLOGY 5-0

This course is a survey of synoptic meteorology, designed to serve as a preparation for study of the various topics considered in the several subsequent advancee courses in meteorology, and as a preparation for laboratory study of weather map analysis and forecasting. It studies successively the thermodynamic properties of air and water vapor; the radiative properties of the earth and its atmosphere; the general circulation of the atmosphere and of the oceans; and the major aspects of anr-mass and frontal analysis.

Texts: Descriptive Meteorology; Willett: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisite: None.

Mr-211(C) WEATHER MAPS AND CODES 2-6

This course is concerned with the problems of observing, transmitting, and preparing for analysis the facts of the state of the atmosphere. It therefore considers the methods, instruments, and conventions used in observing and the reduction of the observed facts into short coded messages; the decoding and plotting of the data on the standard charts used for weather analysis. A series of lectures and motion pictures is presented to give the student officers an outline of the prmnciples of meteorology.

Texts: Hydrographic Office Publication H.O. 206; U. S. Weather Bureau - Circulars "S" and "N", Radiosonde Code, International Code: Aerographer's Manual.

Prerequisites: None

Mr-212(C) SURFACE WEATHER MAP ANALYSIS 1-12

The first principles of surface weather map analysis are demonstrated by having the students analyze an idealized series of weather maps based upon weather observations in the United States. This series is accompanied by a written discussion of each map, giving the criteria to be applied for acceptable analysis. A sequence of maps, at three-hourly intervals, is next analyzed in order to develop concepts of historical sequence and movements of systems This concerns data for North America and the Eastern and Western approaches thereto. The last half of the course is devoted to daily analysis of the current weather charts, including ocean areas; correlation of upper winds with the surface data; practical observations of local weather elements; group discussions of the map analysis; and trial forecasting

Text: Handbook of Meteorology; Berry, Bollay, Beers: Practical Aids in Weather Map Analysis; Lockhart: Weather Analysis and Forecasting; Petterssen.

Prerequisite: Mr-211(C).

Mr-213(C) MAP ANALYSIS AND FORECASTING 0-9

This course is a continuation of Course Mr-212(C). More advanced methods of current weather map analysis and forecasting are presented. The air-mass and frontal concepts are stressed, and the application of analysis and forecast techniques previously presented in the theoretical Course Mr-210(C) are brought out.

Text: None.

Prerequisites: Mr-212(C); Mr-210(C)

Mr-214(C) WEATHER ANALYSIS AND FORECASTING 2-9

This is a continuation of Course Mr-213(C). The students are taught the usefulness of upper-air observations in determining air-mass characteristics, movements, etc.; and the correlation of these observations with the surface map analysis and the forecasts. This, together with additional surface analysis techniques and practical applications of the Technical Course Mr-321(A) introduces the students to three-dimensional weather analysis. Map discussions and practics forecasting are continued.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Weather Analysis and Forecasting; Petterssen: Constant Pressure Analysis; NavAer 50-1R-177: Constant Pressure and Differential Analyses; Haltiner and Eaton: NavAer 50-1R-216.

Prerequisites: Mr-213(C); Mr-411(B).

Mr-221(B) WEATHER ANALYSIS AND FORECASTING 2-9

This course continues the instruction given in Course Mr-214(C). The students are required to become familiar with upper-level charts, and prepare surface prognostic charts. These are correlated with the surface map analysis to give a three-dimensional analysis. The weather analysis discussions and forecasts are continued.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Weather Analysis and Forecasting; Petterssen; A collection and Evaluation of Weather Forecasting Rules; NavAer 50-1R-204.

Prerequisites: Mr-214(C); Mr-321(A); Mr-412(A)

Mr-222(B) WEATHER ANALYSIS AND FORECASTING 0-12

A continuation of Course Mr-221(B)

Text: None.

Prerequisites: Mr-221(B); Mr-322(A).

Mr-223(B) ADVANCED WEATHER ANALYSIS AND FORECASTING 0-9

A continuation of Course Mr-222(C) with the addition of surf and swell forecasting.

Text: None

Prerequisites: Mr-222(B); Mr-229(A); Mr-323(A).

Mr-224(B) ADVANCED WEATHER ANALYSIS AND FORECASTING 0-15

This course is a continuation of Course Mr-223(C). The student officers are taught to analyze and forecast the weather in accordance with the most advanced methods, using all available sources of information, including the surface maps, local conditions, upper-level charts, winds aloft, and meterograph and radiosonde observations. The course is coordinated with Course Mr-225(B) wherein the upper-level charts are drawn, and differential analyses, cross-sections and prognostic charts are prepared. In addition, the students are required to analyze special weather sequences for selected localities of the world.

Text: None.

Prerequisite: Mr-223(B).

Mr-225(B) UPPER-AIR ANALYSIS 0-10

The course is devoted entirely to upper-air analysis (supplemented by surface map analysis in Mr-224(B) including constant-pressure analysis, cross-sections, etc.

Text: None

Prerequisite: Mr-223(B)

Mr-228(A) SOUTHERN HEMISPHERE AND TROPICAL METEOROLOGY 2-0

The course consists of lectures and reading assignments dealing with the synoptic aspects of Southern Hemisphere meteorology, tropical synoptic models (with particular emphasis on the tropical cyclone), and tropical forecasting.

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Climatology; Haurwitz, Austin

Prerequisites: Mr-321(A); Mr-214(C).

Mr-229(A) SELECTED TOPICS IN APPLIED METEOROLOGY 2-0

The course consists of lectures and reading assignments dealing with isentropic analysis, single-station analysis, arctic and antarctic meteorology, extended range forecasting, and any important recent developments in meteorological practice.

Texts: Basic Principles of Weather Forecasting; Starr

Prerequisites: Mr-221(B); Mr-322(A)-

Mr-301(C) SYNOPTIC METEOROLOGY I 5-0

This course deals with the fundamental theoretical concepts of synoptic meteorology, covering air-mass and frontal characterists, wind and pressure systems, the general circulation, climatology, and oceanography.

Texts: Weather Analysis and Forecasting; Petterssen: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-200(C); Ph-190(C); Ma-161(C).

Mr-302(C) SYNOPTIC METEOROLOGYII 5-0

This course is a continuation of Mr-301(C), covering such topics as the thermal wind, differential analysis, the mechanism of pressure changes; stability and instability, Southern Hemisphere and tropical synoptic meteorology, long range and single-station forecasting.

Texts: Weather Analysis and Forecasting; Petterssen: Handbook of Meteorology; Berry, Bollay, Beers.

Prerequisites: Mr-301(C); Mr-402(C); Ma-162(C)

Mr-321(A) DYNAMIC METEOROLOGY I 3-0

The course consists of lectures and concurrent reading assignments from the texts on the following topics: scalar and vector fields; surfaces of discontinuity; solenoids and the Circulation Theorems; tertiary circulations; secondary circulations of thermal and dynamic types; streamlines and trajectories; hydrostatics and the thermal wind; stability, convection and subsidence.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-411(B); Mr-210(C); Ph-196(C); Ma-103(B).

Mr-322(A) DYNAMIC METEOROLOGY I I 3-0

The course is a continuation of Mr-321(A), covering the following topics: continuity and tendency equations; convergency and divergence; vorticity; frontogensis and frontolysis; stability, convection and subsidence, the General Circulation and its influence on the formation of air masses.

Texts: Dynamic Meteorology; Holmboe, Forsythe, Gustin: Weather Analysis and Forecasting; Petterssen.

Prerequisites: Mr-321(A); Ma-134(A)

Mr-323(A) DYNAMIC METEOROLOGY III 3-0

This course is a continuation of Mr-322(A) and considers the following topics: general effects of viscosity; equations of motion for laminar and turbelent flow; dynamic similarity; wind variation in the surface layer; energy changes in wind system; transfer of air properties by turbelent mass exchange; diurnal temperature variations; transformation of air masses,

Texts: Handbook of Meteorology; Berry, Bollay, Beers: Physical and Dynamical Meteorology; Brunt.

Mr-402(C) METEORLOGICAL CHARTS AND DIAGRAMS 3-0

The course proceeds from a treatment of elementary thermodynamics to its applications to meteorology, with particular emphasis on thermodynamic charts and diagrams. Atmospheric stability and the techniques for forecasting instability phenomena are discussed.

Texts: Mimeographed Notes titled "Elementary Meteorological Thermodynamics; Haltiner.

Prerequisites Ph-190(C); Ma-161(C)

Mr 403(C) PHYSICAL METEOROLOGY 4-0

This course is a qualitative treatment of (1) radiation, solar and terrestrial, and its effect on atmospheric processes; (2) elementary theory of turbulence and diffusion and the effect of these processes on wind structure and air mass modification.

Texts: Handbook of Meteorology, Berry, Bollay, Beers. Dynamic Meteorology, Haurwitz.

Prerequisites: Ph 190(C), Ma 162(C).

Mr-404(C) WAVE, SWELL AND SURF FORECASTING 1-2

The student officers are required to solve problems from the texts and make practice forecasts.

Texts: Wind Waves and Swell, Hydrographic Office Publication H. O. Misc. 11,275. Breakers and Surf, H. O. 234.

Prerequisites: Mr 302(C), Mr-403(C).

Mr-410(C) METEOROLOGICAL INSTRUMENTS 2-2

Standard naval meteorological instruments are studied and used by the student. Additional instrumentation peculiar to (1) cold climates, (2) very high elevations, and (3) micrometeorological elements is investigated generally. Special attention is paid to errors and to reliability of observation.

Texts: Meteorological Instruments, Middleton. Aerographer's Manual; Circular 'P', U. S. Weather Bureau. Instrument Workbook, Frcm.

Prerequisite: Ph 196(C) or Ph-190(C).

Mr-411(B) THERMODYNAMICS OF METEOROLOGY 5-2

This course considers the following topics: the physical variables; first and second laws of thermodynamics; concept of entropy, equation of state; properties of gases; properties of water and moist air; thermodynamic diagrams; air mass identification indices; geopotential determinations; stability criteria.

Texts: Dynamic Meteorology, Holmboe, Forsythe, Gustin. Handbook of Meteorology, Berry, Bollay, Beers.

Prerequisites: Mr 210(C), Ma 102(C), Ph 196(C).

Mr-412(A) PHYSICAL METEOROLOGY 3-0

This course deals with (1) solar and terrestrial radiation, and (2) the physics of atmospheric phenomena in which optical or scattering effects are produced by clouds, fogs, raindrops, haze, etc.

Texts: Handbook of Meteorology, Berry, Bollay, Beers. Physical Meteorology, Albright.

Prerequisites: Ph 196(C), Mr-411(B), Ma-103(B).

Mr-420(A) WAVE, SWELL AND SURF FORECASTING 2-0

This course considers the following topics: the characteristics of surface water waves; generation of waves; methods of forecasting sea and swell; methods of forecasting breakers and surf conditions; under water depth detdrminations; and methods of locating rubber rafts adrift at sea.

Texts: Wind Waves and Swell; Hydrographic Office Publication H.O. Misc. 11,275: Breakers and Surf; H.O. 234

Prerequisites: Mr-322(A); Ma-135(C).

Mr-422(A) THE UPPER ATMOSPHERE 5-0

A study of selected topics in Physics which lead to an understanding of the physical structure of the high atmosphere. These topics will be selected from (1) sound, (2) kinetic theory, (3) electromagnetic theory, and (4) atomic structure and spectroscopy. Using these tools, the various stratospheric layers are analyzed in order to determine the variation of composition and of the meteorological elements with height.

Texts: Modern Physics; Jauncey: Terrestrial Magnetism and Electricity; Fleming: Physical State of the Upper Atmosphere; Haurwitz.

Prerequisites: Mr-323(A); Mr-412(A)

Mr-510(C) CLIMATOLOGY 2-0

This course considers the major continental and oceanic regions of the world with respect to their dominant weather characteristics and covers the meteorological and oceanographic processes that are important in the development of these characteristics.

Text Climatology; Haurwitz, Austin.

Prerequisites: Mr-212(C); Mr-210(C).

Mr-810(C) SEMINAR 2-0

Students study and prepare synopses of current publications and original data, concerning meteorology, and present them for group discussion.

Text: None

Prerequisite: Mr-229(A)

Mr-921(A) THESIS I 2-0

Students are expected to begin research on problems selected by themselves or assigned to them. Each student will be directed and assisted in his work by a staff member qualified in the special field of the problem selected.

Text: None.

Prerequisites: Mr.229(A); Mr-323(A); Ma-331(A)

Mr-922(A) THESIS II 4-0

This course is a continuation of Mr-921(A). The work begun in Mr-921(A) will be completed and prepared in proper form for presentation to the Academic Council and/or for publication.

Text: None

Prerequisites: Mr-921(A); Mr-422(A)

METALLURGY

Mt Courses

Production Metallurgy	Mt-101(C)
Production of Steel	Mt-102(C)
Production of Non-Ferrous Metals	Mt-103(C)
Introduction to Physical Metallurgy	Mt-201(C)
Ferrous Physical Metallurgy	Mt-202(C)
Physical Metallurgy (Special Topics)	Mt-203(B)
Physical Metallurgy	Mt-204(A)
Advanced Physical Metallurgy	Mt-205(A)
Advanced Physical Metallurgy	Mt-206(A)
High Temperature Materials	Mt-301(A)
Alloy Steels	Mt-302(A)
Metals Seminar	Mt-303(A)
Radiography	Mt-401(A)
Physics of Metals	Mt-401(A)

Mt-101(C) PRODUCTION METALLURGY 2-0

This course serves as an introduction to the study of metallurgy and is essentially descriptive in nature. Subjects treated include, the occurrence and classification of metal bearing raw materials; the fundamental processes of extractive metallurgy; refractories, fuels, fluxes slags and equipment; a brief summary of steel making and the production of copper and zinc.

Text: Engineering Metallurgy (1938); Stoughton, Butts

Prerequisite: Ch-101(C), Ch-121(B), or concurrently with either.

Mt-102(C) PRODUCTION OF STEEL 3-0

The subject matter includes such topics as the occurrence and composition of various iron ores, the blast furnace, its design and operation, blast furnace products. The various methods of steel production and the production of grey, white and malleable cast iron

Text: Ferrous Production Metallurgy; Bray.

Prerequisites: Ch-101(C) or Ch-121(B)

Mt-103(C) PRODUCTION OF NON-FERROUS METALS 3-0

The subject matter of this course includes a discussion of the sources, the strategic importance of, and the methods of production of the following metals: copper, zinc, lead, tin, aluminum, magnesium and other metals of technical interest.

Text: Non-ferrous Production Metallurgy; Bray

Prerequisites: Ch-101(C) or Ch-121(B)

Mt-201(C) INTRODUCTORY PHYSICAL METALLURGY 3-2

This course serves as an introduction to physical metallurgy. Subjects treated include (a) the nature, characteristics and properties of metals, (b) the application of the phase rule to binary and ternary alloy systems and characteristic phase diagrams, (c) the correlation of microstructure, mechanical properties and corrosion resistance of alloys with phase diagrams (d) mechanical deformation and heat treatment of alloys and (e) descriptions of representative non-ferrous alloys of commercial importance. The subject matter is illustrated by reference to technically important alloy systems in which the phenomena are commonly observed.

The laboratory experiments are designed to introduce to the student the methods available to the metallurgist for the study of metals and alloys. These include the construction of equilibrium diagrams and metallographic studies of fundamental structures, brass, bronze, bearings, etc.

Text: Principles of Physical Metallurgy; Coonon: Engineering Physical Metallurgy; Heyer.

Prerequisite: None.

Mt-202(C) FERROUS PHYSICAL METALLURGY 3-2

This course continues the presentation of subject matter introduced in Metals, Mt-201, with emphasis on the alloys of iron. Subjects treated include (a) the iron-carbon alloys, (b) effects of various heat treatments and cooling rates on the structure and properties of steel, (c) isothermal reaction rates and the hardenability of steel, (d) surface hardening methods, (e) characteristics and properties of plain carbon and alloy cast irons, (f) the effect of other alloying elements on steel, (g) tool steels, (h) corrosion and corrosion resisting steels.

The laboratory work includes experiments in the heat treatment of steel, mechanical testing and metallegraphic examination of common ferrous alloys.

Text: Principles of Physical Metallurgy; Coonan. Engineering Physical Metallurgy; Heyer.

Prerequisite: Mt-201(C).

Mt-203(B) PHYSICAL METALLURGY (SPECIAL TOPICS) 2-2

This course is a continuation of material presented in Mt-201(C) and Mt-202(C). The subject matter covered includes discussions of casting and welding, developments in powder metallurgy, creep and fatigue of metals, material defects and non-destructive testing, light alloys, and the special characteristics of alloys for electrical purposes, armor and armament, titanium and strategic materials.

Texts: Engineering Physical Metallurgy; Heyer Principles of Physical Metallurgy; Coonan Metal Process Engineering; Woldman Heat Treating Aluminum Alloys; Reynolds Metal Co. Selected outside reading.

Prerequisites: Mt-202(C).

Mt-204(A) PHYSICAL METALLURGY 3-4

The material presented in this course includes a study of phase transformations in steel, isothermal decomposition reactions and products, decomposition on continuous cooling, factors involved in hardenability and methods of evaluating it; time, temperature, transformation, mechanical and heat treatment of steel, alloy steels, high strength cast irons and cast steels.

Text: Steel and Its Heat Treatment Vol. I - II - III, Bullens, 5th Ed.

Prerequisites: Mt- 201(C), Mt-202(C)

Mt-205(A) ADVANCED PHYSICAL METALLURGY 3-4

The subject matter includes a discussion of equilibrium in alloy systems, structure of metals and alloys, phase transformations and diffusion.

Text: Structure of Metals - Barrett.

Prerequisites: Mt-202(C), Cr-271(B).

Mt-206(A) ADVANCED PHYSICAL METALLURGY 3-2

The subject matter is an extension of that offered in Mt-205(A) and includes such topics as plastic deformation, theories of slip, recrystallization, preferred orientation, age hardening, etc

Text: Structure of Metals, Barrett; Progress in Metal Physics, Chalmers

Prerequisite: Mt-205(A)

Mt-301(A) HIGH TEMPERATURE MATERIALS 3-0

This course includes a study of the methods used in evaluating the probable behavior of materials at elevated temperatures a consideration of the properties of particular importance in such service; evaluation of present heat resisting alloys; a study of the effect of high temperature on the behavior of alloys; metals used in gas turbines, jets, and rocket motors. A study of ceramics as possible materials for high temperature service is included and a consideration of corrosion and the status of strategic metals.

Prerequisites: Mt-201(C), Mt-202(C)

Mt-302(A) ALLOY STEELS 4-2

The subject matter covered includes a thorough study of the effects of the alloying elements, including carbon, commonly used in steel making on the characteristics of steels in the annealed, the hardened and the hardened and tempered conditions. The principles elucidated are subsequently applied to studies of the classes of steels used for structural purposes, machinery (S.A.E. and A.I.S.I. grades), electrical purposes tools, and corrosion resisting purposes.

Text: The Alloying Elements in Steel; E. C. Bain.
References and reading assignments in other books and current literature.

Prerequisites: Mt-202(C), Mt-204(A).

Mt-303(A) METALLURGY SEMINAR 1-0

Papers from current technical journals will be reported and discussed by students.

Text: None

Prerequisites: Mt-203(B), 204(A), or 205(A)

Mt-304(C) RADIOGRAPHY 2-2

This course covers the principles of X-Ray and gamma ray radiography, including a discussion of high voltage equipment, film characteristics and a comparison of radiography with other non-destructive methods of inspection.

Text: None

Prerequisites: Mt-202(C)

Mt-401(A) PHYSICS OF METALS 3-0

A discussion of crystal chemistry and modern theories of the solid state. Topics considered are the wave nature of electrons, the electron theory of metals, reaction kinetics, free energy of alloy phases, order-disorder transformations, etc.

Text: Theoretical Structural Metallurgy; Cottrell

Prerequisites: Mt-205(A), Ph-610(B), or 640(B)

NE-101(C) MAIN PROPULSION 3-0

A practical study of naval steam-turbine-reduction-gear propulsion plants and their auxiliaries. Subject treated include boilers, forced draft blowers, fuel oil and fuel oil equipment, boiler feed water systems, piping and valves, gaskets and packing, pumps and governors, main turbines, condensers and air ejectors, reduction gears, bearings and shafting propellors, lubrication and lubricants.

Text: Bureau of Ships Manual, Naval Machinery 1946, Bureau of Ships Bulletins of Information.

Prerequisites: None.

NE-102(C) AUXILIARY MACHINERY 3-0

A practical study of naval machinery other than main propulsion machinery. Subjects trezted include auxiliary turbines, mechanical measuring instruments, hydraulic speed gears, diesel (auxiliary) engines, compressed air plants, welding and cutting, distilling plants, refrigeration plants, electrical plants (general), generators and voltage regulators, electrical distribution systems, storage batteries, motors and controllers, lighting, interior communication systems, searchlights and electrical measuring instruments.

Text: Bureau of Ships Manual Naval Machinery 1946, Bureau of Ships Bulletins of Information.

Prerequisites: None

NE-103(C) ENGINEERING DEPARTMENT ORGANIZATION 1-0

A study of the administrative duties of the engineering office afloat. Subjects treated include: Engineering Department Organization, Routine Tests and Inspections, Machinery Index, Machinery History Current Ship's Maintenance Project, Ship's Force Overhauls, Tender Overhauls, Navy Shipyard Overhauls, Supplies Spare Parts, Requisitions, Engineering Casualty Control, Safety Precautions, Engineering Competition, and Economical Operation of Engineering Plants.

Text used is prepared lecture stencils.

Prerequisites: None.

ORDNANCE and GUNNERY

Or Courses

Ordnance Administration	Or-110(C)
Surface Fire Control	Or-120(C)
Anti-Aircraft Fire Control	Or-131(C)
Anti-Aircraft Fire Control	Or-132(C)
Guided Missiles	Or-141(C)
Guided Missile Guidance	Or-142(C)
Underwater Ordnance	Or-151(C)
Underwater Ordnance	Or-152(C)

NEW WEAPON DEVELOPMENT

SL Lecture Courses

New Weapon Development I	SL-101
New Weapon Development II	SL-102

Or-110(C) ORDNANCE ADMINISTRATION 2-0

Organization and administration of the Bureau of Ordnance and Ordnance Shore Establishments, Duties of the Gunnery Officer.

Texts: Navy Dept. Classified Publications.

Prerequisites: None.

Or-120(C) SURFACE FIRE CONTROL 2-0

Fundamentals of the surface fire control problem, rangekeeper theory, director systems, synchros, fire control errors and correctors, battery alignment, basic mechanisms.

Texts: Navy Dept. Classified Publications.

Prerequisite: None

Or-131(C) ANTI-AIRCRAFT FIRE CONTROL 1-2

Fundamentals of the anti-aircraft fire control problem, analytical solution of the anti-aircraft fire control problem, basic mechanisms, range-keeper and computer theory, units making up one anti-aircraft fire control system, introduction to fire control errors and correctors.

Texts: Navy Dept. Classified Publications.

Prerequisite: Or-120(C) (or equivalent)

Or-132(C) ANTI-AIRCRAFT FIRE CONTROL 2-0

Review of the fundamentals of the anti-aircraft fire control problem, theory of gyro lead computing systems, basic electro-mechanical computing equipment.

Texts: Navy Dept. Classified Publications.

Prerequisite: Or-131(C) (or equivalent).

Or-141(C) GUIDED MISSILES 2-0

Introduction to guided missiles and guidance systems.

Texts: Navy Dept. Classified Publications.

Prerequisite: None.

Or-142(C) GUIDED MISSILE GUIDANCE 1-0

This course is a continuation of Or-141(C) and consists of a survey of guidance systems and guided missiles.

Texts: Navy Dept. Classified Publications.

Prerequisites: Or-141(C) (or equivalent).

Or-151(C) UNDERWATER ORDNANCE 2-0

Moored and ground mines, contact and influence firing mechanisms, depth charges and other antisubmarine ordnance, steam, electric and chemical torpedoes, theory and design of torpedo control equipment, harbor defense, nets and booms.

Texts: Navy Dept. Classified Publications.

Prerequisites: None

Or-152(C) UNDERWATER ORDNANCE 2-0

Mathematical aspects of minefield planning, detailed design of influence firing mechanisms, design of mine accessories, moored and ground mine sweeping and location, harbor defense.

Texts: Navy Dept. Classified Publications.

Prerequisites: None.

SL-101 NEW WEAPON DEVELOPMENT I 0-1

(Lecture)

This course consists of the first ten (10) lectures of a twenty (20) lecture series to be delivered by authorities in the field of New Weapon Development, the latter term being used in its broadest sense and including such developments as atomic energy, guided missiles, pilotless aircraft, radar, special communication equipment, countermeasures, special fuzes, and jet propulsion.

Prerequisites: None

SL-102 NEW WEAPON DEVELOPMENT II 0-1

(Lecture)

This course is a continuation of Course SL-101 and consists of the second ten (10) lectures of the twenty (20) lecture series described under SL-101.

Prerequisites: None

Ph Courses

Dynamics	Ph-113(B)
Analytical Mechanics	Ph-141(B)
Analytical Mechanics	Ph-142(B)
Advanced Mechanics	Ph-143(A)
Introduction to Physics (Meteorology)	Ph-190(C)
General Physics (Meteorology)	Ph-196(C)
Geometrical and Physical Optics	Ph-211(C)
Physical Optics and Introductory Dynamics	Ph-212(B)
Geometrical and Physical Optics	Ph-240(C)
Polarized Light	Ph-241(B)
Geometrical and Physical Optics	Ph-250(C)
Electricity	Ph-311(B)
Electricity and Magnetism	Ph-341(C)
Electricity and Magnetism	Ph-342(B)
Electricity and Magnetism	Ph-343(B)
Electromagnetism	Ph-361(A)
Electromagnetic Waves	Ph-362(A)
Sound	Ph-410(B)
Fundamental Acoustics	Ph-421(A)
Applied Acoustics	Ph-422(A)
Sonar Systems	Ph-424(A)
Acoustics Laboratory	Ph-426(B)
Underwater Acoustics	Ph-450(B)
Thermodynamics	Ph-530(B)
Kinetic Theory and Statistical Mechanics	Ph-540(B)
Atomic Physics	Ph-610(B)
Atomic Physics	Ph-631(B)
Atomic Physics	Ph-640(B)
Introduction to Quantum Mechanics	Ph-721(A)
Physics of the Solid State	Ph-722(A)
Theoretical Physics	Ph-731(A)
Theoretical Physics	Ph-732(A)

Ph-113(B) DYNAMICS 3-0

Kinematical and dynamical motions of a particle and of rigid bodies, energy concepts in dynamics, constrained motion, equations of Lagrange and of Hamilton. Both analytical and vector methods are used.

Text: Physical Mechanics: Lindsay.

Prerequisites: Ma-102(C); Ph-212(B).

Ph-141(B) ANALYTICAL MECHANICS 4-0

Fundamental dynamical concepts, oscillator theory, curvilinear motion in a plane, energy concepts, statics and dynamics of a rigid body, both analytical and vector methods are used.

Text: Physical Mechanics; Lindsay: Introduction to Theoretical Physics; Page: Principles of Mechanics; Synge and Griffith.

Prerequisite: Ma-182(B) (may be taken concurrently)

Ph-142(B) ANALYTICAL MECHANICS 4-0

Wave motion, fluid mechanics, constrained motion, Hamilton's Principle, Lagrange's equations.

Prerequisite: Ph-141(B); Ma-183(B) (may be taken concurrently)

Ph-143(A) ADVANCED MECHANICS 3-0

A continuation of Ph-142(B)

Prerequisite: Ph-142(B)

Ph-190(C) INTRODUCTION TO PHYSICS (Meteorology) 3-0

Elementary concepts and laws of statics and dynamics. Introduction to the statics and dynamics of fluids. Temperature, heat, radiation and kinetic theory. The gas laws. Rudiments of vector representation and notation.

Text: Introduction to Physics, Howe.

Prerequisite: None.

Ph-196(C) GENERAL PHYSICS (Meterology) 5-1

The course is a survey of the mechanics of solids and fluids, heat and kinetic theory, and wave motion.

Text: Analytical Experimental Physics; Lemon, Ference.

Prerequisite: None.

Ph-211(C) GEOMETRICAL AND PHYSICAL OPTICS 3-0

Reflection and refraction of light, lenses and lens aberrations, stops, optical systems, dispersion, and interference.

Text: Optics; Sears: Physical Optics; Jenkins, White.

Prerequisite: None.

Ph-212(B) PHYSICAL OPTICS AND INTRODUCTORY DYNAMICS 3-3

A continuation of Ph-211(C). An analytical presentation of diffraction, polarization, optical behavior of radio waves. Introductory dynamics. Related laboratory work in optics is included.

Text: Physical Optics; Jenkins and White: Physical Mechanics; Lindsay.

Prerequisite: Ph-211(C).

Ph-240(C) GEOMETRICAL AND PHYSICAL OPTICS 3-3

Reflection and refraction of light, lenses, optical systems, dispersion, interference, diffraction, polarization.

Text: Optics, Sears; Physical Optics, Jenkins and White.

Prerequisite: None.

Ph-241(B) POLARIZED LIGHT 1-3

Primarily a laboratory course in polarized light. The following experiments are included: Polarization phenomena caused by transmission of light through crystals, polarization by reflection from dielectrics, reflection from metals and optical constants of metals, analysis of elliptically polarized light, wave plates, and optical activity.

Text: Lecture notes.

Prerequisite: Ph-240(C).

Ph-250(C) GEOMETRICAL AND PHYSICAL OPTICS 3-2

Reflection and refraction of light, lenses, lens systems, dispersion, interference, diffraction.

Text: Optics, Sears; Physical Optics, Jenkins and White

Prerequisite: None.

Ph-311(B) ELECTROSTATICS AND MAGNETOSTATICS 3-0

Coulomb's law, Gauss' law, dipoles, dielectric theory, polarization, harmonic solutions of Laplace's equation, electrical images, magnetic dipoles and shells, Ampere's law, magnetic field of current, magnetic theory. Both analytical and vector methods are used.

Text: Principles of Electricity and Electromagnetic; Harnwell.

Prerequisite: Ma-103

Ph-341(C) ELECTRICITY AND MAGNETISM 4-2

DC and AC circuits, elementary electrostatics, vacuum tubes, couples circuits, filters, lines, vacuum tube circuits; the treatment being such as to emphasize the physical aspects of these phenomena.

Text: Principles of Electricity and Magnetism, Harnwell.

Prerequisite: Ma-182(B) (may be taken concurrently).

Ph-342(B) ELECTRICITY AND MAGNETISM 3-3

A continuation of Ph-341(C)

Vacuum tube circuits, oscillators, transients, multivibrators, pulse shaping circuits, non-ohmic circuits, photoelectric effects, electrostatics, dielectrics, condustors and eletromagnetic effects of steady currents.

Text: Principles of Electricity and Magnetism, Harnwell

Prerequisite: Ph-341(C)

Ph-343(B) ELECTRICITY AND MAGNETISM 3-0

A continuation of Ph-342(B)

Eldctromagnetic theory including such topics as time varying electric currents, theory of magnetism, Maxwell's equations, electromagnetic waves in free space, in dielectrics and in conducting media and elementary theory of gaseous conduction. Analytic and vector methods are used. The last three or four weeks are devoted to Nuclear physics instrumentation.

Text: Principles of Electricity and Magnetism: Harnwell. Lecture Notes

Prerequisite: Ph-342(B)

Ph-361(A) ELECTROMAGNETISM 3-0

Electromagnetic field theory; electrostatics; dielectrics; magnetic fields of currents; vector potential; magnetic materials; magnetomotive force; electromagnetic induction; Maxwell's equations; electromagnetic waves.

Text: Electromagnetism; Slater, Frank

Prerequisites: Ma-104(A), EE-272(C)

Ph-362(A) ELECTROMAGNETIC WAVES 3-0

A continuation of Ph-361(A)

Reflection and refraction of electromatic waves; wave guides; cavity resonators; electromagnetic radiation.

Text: Electromagnetism, Slater, Frank

Prerequisite: Ph-361(A)

Ph-410(B) SOUND 3-0

This course provides a brief survey of vibrating systems, and of the problems arising in connection with the radiation, transmission and reception of sound in air and in water.

Text: Fundamentals of Acoustics, Kinsley, Frey

Prerequisite; Ma-102(C)

Ph-421(A) FUNDAMENTAL ACOUSTICS 3-0

An analytical study of the dynamics of vibrating systems including free, forced, damped, and coupled simple harmonic motion; vibrations of strings, bars, membranes, and diaphrams. A development of the acoustic wave equation. Propagation of plane waves through pipes and between different media. Propagation of spherical waves including radiation from pulsating sphere and circular piston.

Text: Fundamentals of Acoustics; Kinsler, Frey

Prerequisite: Ma-104(A)

Ph-422(A) APPLIED ACOUSTICS 3-0

A continuation of Ph-421(A)

An analytical treatment of acoustic resonators; acoustic impedance; effects of branches, orifices, and viscosity on propagation of plane waves through pipes; horn, loud speaker, and microphone theory and practice. Fundamentals of acoustical measurements including rating and calibration methods of microphones and loud speakers. Architectural acoustics. Fundamentals of hearing.

Text: Fundamentals of Acoustics, Kinsler, Frey

Prerequisite: Ph-421(A)

Ph-423(A) UNDERWATER ACOUSTICS 2-3

A continuation of Ph-422(A)

An analytical treatment of the piezoelectric effect and the magnetostriction effect with applications to sonar transducers and to crystal oscillators, transmission of sound in sea water including problems of refraction, attenuation and reverberation. Physics principles and electronic circuits used in design and operation of modern sonar equipment. Experiments in acoustical measurements, sound beam and sonar equipment measurements, operation of sonar equipment.

Text: Principles of Underwater Sound; NDRC Technical Summary.

Prerequisite: Ph-422(A)

PH-424(A) SONAR SYSTEMS AND DEVELOPMENTS 2-3

Various types of sonar equipment and new developments are studied in the laboratory (Sonar Barge) and in the classroom.

Prerequisite: Ph-423(A) or PL-450(B)

PH-426(B) ACOUSTICS LABORATORY 3-2

A laboratory course to accompany Ph 421(A). An experimental study of vibrating systems and acoustic radiations.

Prerequisits: None

Ph-450(B) UNDERWATER ACOUSTICS 3-2

An analytic treatment of the fundamentals of acoustics, with particular emphasis on sound radiation and transmission problems encountered in underwater acoustics:

Text: Fundamentals of Acoustics, Kinsler, Frey; NDRC Tech. Summary, Principles of Underwater Sound.

PrerequisiteL Ma-102(C)

Ph-530(B) THERMODYNAMICS 3-0

Fundamental theory of thermodynamics and application to physical problems. First and second laws of thermodynamics, entropy, free energy, the phase rule, gaseous reactions, thermodynamics of dilute solutions, specific heats of gases, the Nernst heat theorem.

Prerequisites: Ph-113(B) or Ph-142(B); Ma-103(B) or Ma-183(B)

Ph-540(B) KINETIC THEORY AND STATISTICAL MECHANICS 3-0

Properties of an ideal gas, the Maxwell-Boltzman distribution, mean free path, collision cross-section, non-ideal gases, viscosity, heat conductivity, diffusion; introduction to classical and quantum statistics, including Fermi-Dirac and Bose-Einstein statistics.

Text: Lecture notes; Kinetic Theory of Gases, Kennard.

Prerequisites: Ph-113(B) or Ph-142(B); Ma-103(B) or Ma-183(B)

Ph-610(B) ATOMIC PHYSICS 3-0

Elementary charged particles, photoelectricity, X-rays, radio-activity, atomic structure, nuclear disintegration.

Text: Atomic Physics; Semat.

Prerequisites: None.

Ph-631(B) ATOMIC PHYSICS 4-0

Dynamics of elementary charged particles, Rutherford's model of the atom and the scattering of alpha particles, Special theory of relativity, black-body radiation, Bohr model of the atom, Schroedinger wave equation, dipole radiation, optical spectra, Zeeman effect, magnetic moments, Pauli's principle, X-rays, photoelectric effect, natural radioactivity, the nucleus, artificial radioactivity.

Text: Atomic Physics, Semat; Introduction to Modern Physics, Richtmeyer and Kennard.

Prerequisite: Ph-311(B) or equivalent

Ph-640(B) ATOMIC PHYSICS 3-3

Same as in PH-631(B) above

Texts: Same as Ph-631(B)

Prerequisite: Same as for PH-311(B)

Ph-721(A) INTRODUCTION TO QUANTUM MECHANICS. 4-0

This course is designed to familiarize the student with the postulates and other fundamental aspects of quantum mechanics. The wave mechanical treatment is applied to such problems as the free particle, particle in a potential well, potential barriers, cold cathode emission, increased emission from a coated filament, natural radioactivity, harmonic oscillator, free rotator, hydrogen atom, and the one-dimensional potential lattice for the solid state. The course terminates with a discussion of the relation of classical mechanics to quantum mechanics.

Text: Lecture notes;

Prerequisites: Ph-249(C), Ph-142(B), Ph-343(B), Ph-610(B) or the equivalent of the above with the consent of the instructor.

Ph-722(A) PHYSICS OF THE SOLID STATE. 3-0

Properties of ionic crystals such as lattice energies, electrical conductivity, absortion, phosphoreseence and fluorescence. The transistor. Properties of metals such as specific heats, electrical conductivity and magnetic susceptibility.

Text: Modern theory of Solids, Seitz.

Prerequisite: Ph-721(A) or equivalent.

Ph-731(A) THEORETICAL PHYSICS

Topics in theoretical physics selected to meet the needs of the student.

Ph-732(A) THEORETICAL PHYSICS

Topics in theoretical physics selected to meet the needs of the student.

PART IV

Groups Commencing Postgraduate Education Away from Postgraduate School

GROUPS COMMENCING POSTGRADUATE EDUCATION AWAY FROM THE NAVAL POSTGRADUATE SCHOOL

CURRICULUM	LOCATION	GROUP DESIGNATION
General Line	Newport, R.I. & Monterey, Calif.	G
Naval Construction and Engineering	M.I.T. & Webb Inst.	NB, NB2, NB3
Nuclear Engineering	M.I.T.	NE
Civil Engineering	Rensselaer Poly, I.	ZG, ZG2
Law	Catholic Univ.	ZHC, ZHC2, ZHC3
	George Washington Univ.	ZHW, ZHW2, ZHW3
	Georgetown Univ.	ZHG, ZHG2, ZHG3
Naval Intelligence	Anacostia, D.C.	ZI
Advanced Man. (13wks)	Harvard Univ.	ZK
Advanced Man.(8wks)	Pittsburgh Univ.	ZKP
Business Admin.	Harvard Univ.	ZKH, ZKH2
	Stanford Univ.	ZKS, ZKS2
	Columbia Univ.	ZKC, ZKC2
Textile Eng.	Giorgia Inst. Tech	ZMG
	Lowell Textile Inst.	ZM2
Personnel Admin. & Trg.	Ohio State	ZPO
	Stanford Univ.	ZPS
Man. and Ind. Eng.	Rensselaer Poly. I.	ZT
Religion	Various	ZU
Oceanography	Scripps Inst. of Ocean.	ZO
Cinematography	U.S.C.	ZCP
Photographic Technology	Rochester Institute of Technology	ZCP

CIVIL ENGINEERING

Qualification Course

Sixteen months of Postgraduate Training at Rensselaer Polytechnic Institute. Troy New York. For details consult the catalogue in question.

Successful completion of this course normally leads to appointment in the Civil Engineer Corps.

This course is built around the educational background of Naval Academy graduates. However, two other classes of candidates will take it.

(a) Those officers who have an educational background at a civilian institution but do not possess an engineering degree. The curriculum for each such officer will have to be adjusted to fit those courses he has taken.

(b) Those officers who are already in the Corps but possess an engineering degree other than Civil, i.e., Electrical, Mechanical, etc. For those officers the course will be approximately 13 months in length and will be their "equalization course". Although their educational backgrounds will vary, they should have enough previous credits among the subjects listed to enable them to complete all of the subjects listed and obtain a BCE degree by the end of the term ending in June. All other students will receive a BCE in September of the year following their entrance in May

COURSE PROGRAM FOR CEC STUDENTS

EQUALIZATION COURSE

For details consult the catalogue in question.

GENERAL LINE

One year graduate training at Newport, R. I. and Monterey, Calif

OBJECTIVE

The objective of the General Line Curriculum is to care for the pressing need to indoctrinate, specifically train, and broaden the professional knowledge of the large number of transferred reserve and temporary officers and of Naval Academy graduates, who, during the past few years, have served in specialized assignments, and to prepare officers having three or four years of narrow experience for the early assumption of broader responsibility aboard ship.

For details consult the catalogue in question.

NAVAL CONSTRUCTION AND ENGINEERING

A three year course at Massachusetts Institute of Technology at Cambridge, Massachusdtts and at Webb Institute of Naval Architecture at Glen Cove, New York, successful completion of which normally leads to designation of Engineering Duty Officer.

Although the curriculum is designed to qualify the student generally for naval construction and engineering assignments, selection of courses is such as to offer advanced work in any one of the following.

Hull Design and Construction
Marine Electrical Engineering
Electronics Engineering
Ship Propulsion Engineering
Nuclear Engineering

All of the above specialties are presented at Massachusetts Institute of Technology. Only the course in Hull Design and Construction is presented at Webb Institute.

The three year curriculum in Nuclear Engineering is a new course. A course of one year in Nuclear Engineering is being conducted to provide nuclear engineers in the interim until graduates of the three year curriculum become available. Input to this one year course is restricted to graduates of the three year course in Naval Construction and Engineering.

Quotas for the above specializations are determined by Chief of the Bureau of Ships.

The three year course may be shortened to two years for students having exceptional scholastic background.

All of the three year curricula lead to a Master's Degree in Naval Construction and Engineering. Details may be found in the catalogues of the two institutions.

NAVAL INTELLIGENCE

Twelve to twenty seven months at Anacostia, D. C.

OBJECTIVE

To train Naval Officers selecting Intelligence as their specialty in all phases of Intelligence, including Strategic, Operational, and Counter Intelligence as required by the Navy. To conduct intensive instructions in foreign languages to meet the needs of the Navy for linguistic officers. To offer instruction in Intelligence and foreign languages to personnel of the other armed services up to the capacity of the school.

CURRICULUM

Six months of classroom instruction in an integrated course in Intelligence, followed by a comprehensive Intelligence problem of six weeks' duration, plus six weeks of practical work in the form of field trips to Fleet and shore units, whose operations include the procurement or collection of Strategic, Operational, or Security Intelligence. Upon the completion of the Intelligence phase, a period of from four and one-half to twenty-two months is spent at the school in the study of a foreign language. The degree of difficulty determines the length of the language-study period.

LAW

Three years of graduate work for selected officers of the Navy in the LAW SCHOOL of George Washington University, Georgetown University, or Catholic University

Considerable latitude is allowed in the exact curriculum followed by the student officer within the framework essential to receiving a degree in law at the university in question. Studies at the Law School are supplemented with work in the Office of the Judge Advocate General of the U S. Navy.

ADVANCED MANAGEMENT

A thirteen week course conducted twice each year, convening in February and September, by the Graduate School of Business Administration, Harvard University, or an eight week course, convening in the fall and spring, as announced by the University of Pittsburgh.

The method of instruction is by means of research studies involving inquiries of several companies or perhaps an industry, and case studies collected from specific business organizations.

The study program for both schools is divided about equally among the following subjects:

(a) Administrative Practices
(b) Cost and Financial Administration
(c) Production Management
(d) Marketing Management
(e) Problems in Labor Relations

At present this course is made available to only a few selected naval officers of the rank of Commander or above and departmental quotas are determined by the Bureau of Personnel.

TEXTILE ENGINEERING

Two years of graduate work for selected officers of the Supply Corps at Lowell Textile Institute at Lowell, Massachusetts, or Georgia Institute of Technology. All officers commencing this course in 1950 will go to Georgia Tech

Inasmuch as student officers are allowed a considerable discretion in the selection of course pursued, dependent upon their individual background, it is impractical to reproduce here all the courses offered at Lowell Institute and available to officers of the Supply Corps Courses are offered which lead to Master's degrees, provided the student has adequate educational background to pursue them satisfactorily.

For details consult the catalogue in question.

CINEMATOGRAPHY

A one year course in Cinematography given to selected officers with previous experience in this field at the University of Southern California and other schools offering courses in this work.

PHOTOGRAPHIC TECHNOLOGY

A two year course in Photographic Technology will be given to selected officers with previous experience in this field at the Rochester Institute of Technology

BUSINESS ADMINISTRATION

A two-year course of Postgraduate instruction conducted at the Harvard Graduate School of Business Administration, the Stanford University Graduate School of Business, and at Columbia University.

OBJECTIVE

To develop the ability in officers to analyze business organizations, problems, and conditions; to acquire an appreciation for and an understanding of business as a whole; and to administer effectively future assignments which may require personal dealings with business and industrial concerns or utilization of business techniques.

University bulletins should be consulted for details of the curricula. In general, officers take courses recommended by faculty advisors at the two schools. The advisors are in close contact with representatives of the various technical Navy Department Bureaus which have officers enrolled and endeavor to have student officers take courses best suited to the respective Bureau's requirements.

PERSONNEL ADMINISTRATION AND TRAINING

A four-quarter (12-month) course of instruction carried on at two Universities, Ohio State and Stanford.

The curricula at the different universities differ in themselves and are adaptable to the individual backgrounds of the students concerned. Considerable elective make-up of personal curricula is allowed.

MANAGEMENT AND INDUSTRIAL ENGINEERING CURRICULUM

One academic year at Postgraduate Education at Rensselaer Polytechnic Institute, Troy, New York. For details consult the catalogue in question.

Latest BuPers Circular Letter on 'Applications for Postgraduate Training' should be consulted to determine eligibility.

This course leads to a degree of Bachelor of Management Engineering.

OCEANOGRAPHY

Two semesters of graduate work in oceanography at Scripps Institute of Oceanography followed by three months at the U.S. Naval Hydrographic Office.

The exact course followed at Scripps will vary with the student officer and be planned by consultation between the Hydrographic Office and Scripps Institute.

RELIGION

Selected chaplains are selected each year to pursue advanced studies in religious and pastoral subjects. The choice of subjects is left largely to the individual concerned; courses vary widely from college to college depending upon the previous background and denominational training of the chaplains concerned.

The schools cooperating with the Navy in this program are:

The Catholic University of America
Fordham University
Harvard University
The Pacific School of Religion
Union Theological Seminary
The Chicago Divinity School